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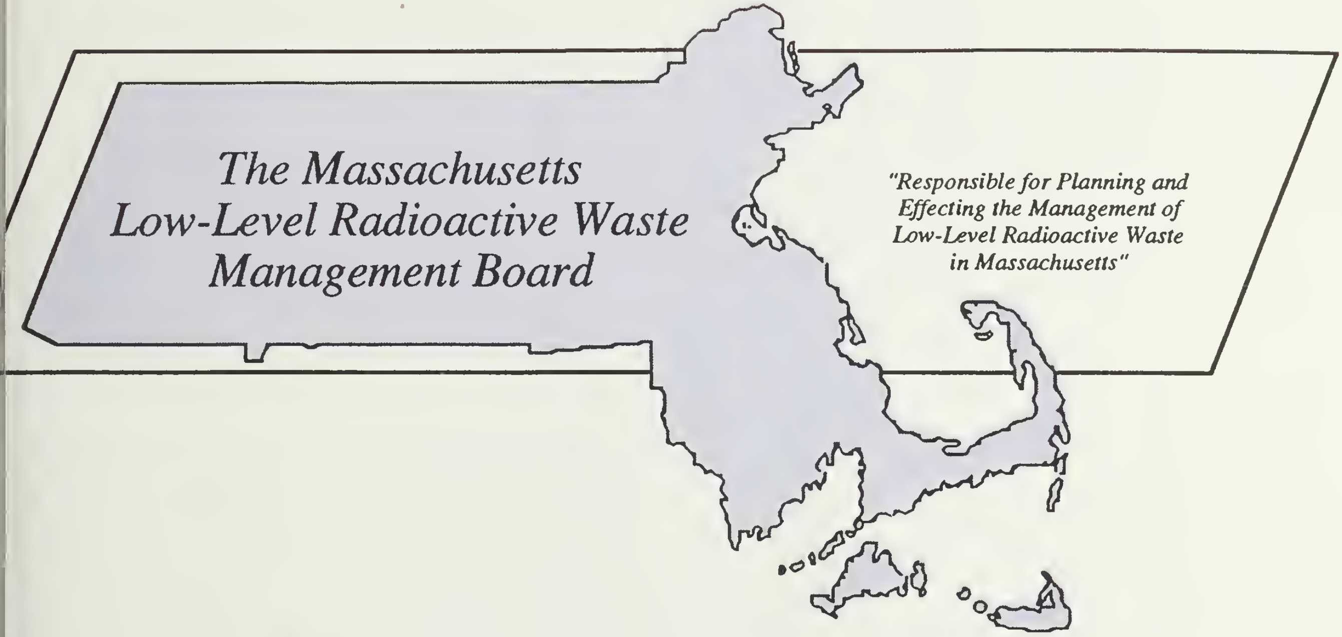
The Massachusetts
Low-Level Radioactive Waste
Management Board
"Responsible for Planning and
Effecting the Management of
Low-Level Radioactive Waste
in Massachusetts"

1990 Massachusetts Low-Level Radioactive Waste Survey Report

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1990 Massachusetts Low-Level Radioactive Waste Survey Report

November 1991

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Deputy Director for Technical Operations

Massachusetts Low-Level Radioactive Waste Management Board

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RESPONSIBLE FOR PLANNING AND EFFECTING THE MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE IN THE COMMONWEALTH

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Introduction

This report presents low-level radioactive waste (LLW) characteristics compiled from the "1990 Low-Level Radioactive Materials Licensee and NARM Users Survey" for Massachusetts.

The report includes:

- data which characterizes LLW produced in Massachusetts in 1989;
- waste projections provided by Massachusetts radioactive materials users for the years 1990-1995;
- data on waste volumes and total activity shipped for disposal as reported by each survey respondent.

This annual survey is required by the Massachusetts General Laws, Chapter 111H. Previous LLW surveys have been conducted as follows:

1. Low-Level Radioactive Waste Management Survey, prepared for EG&G Idaho, Inc. (National Low-Level Waste Management Program, U.S. Department of Energy) and the Massachusetts Department of Public Health, October, 1982;
2. The Analysis of Low-Level Radioactive Wastes Generated in Massachusetts, prepared for the Massachusetts Special Legislative Commission on Low-Level Radioactive Waste, April, 1985;
3. Low-Level Radioactive Waste Generator Survey, conducted for the Massachusetts Low-Level Radioactive Waste Management Board, November, 1989.

Low-level radioactive waste is produced as a by-product of various uses of radioactive materials. Typical applications of radioactive materials include: medical procedures such as diagnostic imaging examinations, radioimmunoassays, diagnosis and treatment of thyroid dysfunction, and cancer diagnosis and treatment; university education and research in medicine, materials properties, biotechnology, and other commercial and industrial areas; research and development in the biotechnology industry for the treatment and prevention of various diseases and medical dysfunctions; industrial radiography of pressure vessel and other structural welds; other commercial uses such as level measurement, thickness measurement, moisture and density analysis, and quality control; commercial and domestic applications in smoke detectors and exit signs; commercial and academic analysis such as gas chromatography; and the production of electricity from nuclear power plants.

More than 400 hospitals, universities, government agencies, biotechnology firms, and other businesses, including the utilities with two nuclear power plants, are licensed by the U.S. Nuclear Regulatory Commission (NRC) or are registered with the Massachusetts Department of Labor and Industries to use radioactive materials in Massachusetts. Of these organizations, the 1990 survey indicates that 89 radioactive materials users produced LLW requiring disposal in a licensed disposal facility in 1989. These disposal facilities are located in Barnwell, South Carolina; Beatty, Nevada; and Hanford, Washington.

The 89 radioactive materials users shipped 58,717 cubic feet of LLW for disposal in 1989. This quantity ranked Massachusetts as the eleventh largest producer of LLW in the country in 1989 in terms of LLW accepted at licensed disposal facilities, but it represents a substantial improvement in waste management practices with respect to previous years. In 1982, for example, Massachusetts shipped almost five times the volume shipped in 1989, placing the Commonwealth first in the nation. Various waste minimization techniques have been implemented by radioactive materials users to achieve this reduction, and additional improvement is expected in the future.

Figure 1 illustrates the trends of waste shipped for disposal between 1981 and 1989, as well as volumes projected by radioactive materials users through 1995.

In addition to LLW volumes, the data summarized in this report also include a description of LLW in terms of the amount of radioactivity shipped for disposal.

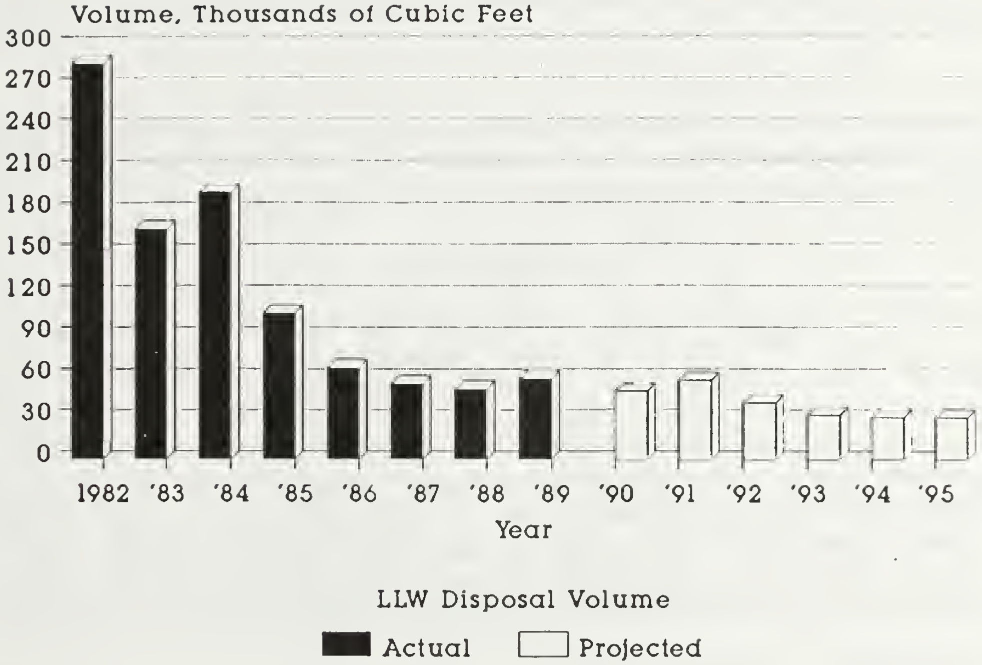
Some radioactive materials users produce LLW whose radioactivity decays[1] to minute quantities in relatively short periods of time (from minutes to a few years). This waste is stored, usually at the radioactive materials users' locations, so that this decay process can occur (called "storage for decay"), and the waste involved does not require disposal in a LLW disposal facility. Approximately 120 organizations generated waste that was managed by storage for decay and other means authorized by NRC.

---

[1] Radioactive atoms "decay," transforming the nucleus of a radioactive atom into the nucleus of another species. The number of nuclear transformations occurring per unit of time is called the "activity." Activity is measured in "curies." A curie is that quantity of a radioactive material that produces 37 billion nuclear transformations or disintegrations per second. As radioactive atoms decay, they eventually yield a more stable and ultimately non-radioactive element.

Figure 1

Historical and Projected LLW Volume Trends
(in cubic feet)



Some licensees use radioactive materials encapsulated in a shell of non-radioactive material. These "sealed sources" enable the radiation which penetrates the shell to be used for various controlled purposes, but prevents radioactive material or contamination from being transmitted outside the sealed shell. The 1990 survey reveals that approximately 161 radioactive materials users utilized sealed sources which did not result in the generation of any LLW from their use. A related LLW waste stream may result from later disposal by the user or manufacturer of sealed sources which are no longer useful.

LLW resulting from the uses of radioactive materials takes a variety of forms. LLW includes radioactively-contaminated dry, solid wastes such as wood, clothing and metal; concentrates from evaporation processes; hardware which has been irradiated as a result of its proximity to certain nuclear radiation sources; filters and filter media used in purifying various process streams; ion exchange resins used in water purification and chemical extraction processes; contaminated aqueous and organic liquids used in various analytical procedures and decontamination processes; contaminated used oils from machinery and processes which use radioactive materials; contaminated soil and rubble from the decommissioning and remediation of various facilities; biological waste such as animal carcasses and tissues from biological and medical research and medical diagnosis and treatment; and sludges from various processes. Also, a small portion of LLW contains hazardous chemicals, or exhibits hazardous materials properties, and is referred to as "mixed" waste.

Types of LLW materials that typically make up the LLW stream in Massachusetts, the types of generators producing LLW, frequently used treatment processes, and the types of containers used for storage and disposal are summarized in Table 1.

Data Categories

Data are grouped within categories that are typically of interest to most reviewers of LLW information: generator category and disposal classification. Generator categories include the following:

1. Commercial - organizations such as biotechnology companies, engineering and construction companies, testing laboratories, radiopharmaceutical manufacturers and suppliers, and companies using radioactive materials for process and quality control and analysis;

2. Academic - universities, colleges, and other research institutions;

3. Health - typically hospitals, clinics, and physicians;

4. Government - local, state, and federal entities such as water districts, transportation departments and authorities, and health departments;

5. Utility - electric power utilities which operate nuclear power plants.

It should be noted that some overlap and relationship exists among these categories. For example, commercial radiopharmaceutical manufacturers produce much of the radioactive materials used in academic and medical research, diagnosis, and treatment. While the use of radioactive materials and the resulting production of LLW is assigned to one category, these materials often are used or produced because of demands from organizations in other generator categories.

As noted, the data are also segregated by disposal classification. This classification system is based upon the NRC system for classifying LLW for disposal and is promulgated in the Code of Federal Regulations, Title 10, Part 61 (10 CFR 61). Four classes of waste are defined:

Class A wastes are characterized by their low concentrations of long-lived radionuclides and concentrations of short-lived radionuclides that will decay to acceptable levels within the assumed 100 year institutional control period when a disposal facility is actively maintained after closure. These concentration limits, specified in 10 CFR 61, have been calculated on the basis of acceptable doses to an inadvertent intruder who might occupy the disposal site and encounter the waste after this time.

Class B wastes are the next level of wastes which could represent a potential hazard to an inadvertent intruder without additional protective measures since they contain higher levels of short-lived radionuclides. They must meet the NRC's stability requirements so that the waste forms or containers can "maintain gross physical properties and identity, over 300 years" [Part 61.7(b)(3)], thus limiting the potential exposure to an inadvertent intruder.

Class C wastes are wastes that, due to their greater concentrations of long-lived or short-lived radionuclides, must meet waste form requirements to ensure stability and must be disposed of in a way to protect the inadvertent intruder for a longer time. These wastes must meet the stability requirements for form or container (300 years) and must be disposed of in a manner which protects against inadvertent intrusion for at least 500 years. [Part 61.52(a)(2)]

Greater than Class C (GTCC) wastes are wastes whose concentrations of radioactive isotopes generally make them unacceptable for the types of disposal used for Classes A, B, and C. GTCC wastes continue to be the responsibility of the federal government, not the states.

TABLE 1

Typical LLW Categories Treatment and Packaging

Waste Category Type	Generator Categories Typically Producing Waste	Typical Treatment Used	Container Types Used For Storage or Disposal
Dry Active Waste (Uncompacted) metal concrete wood hardware	COMMERCIAL ACADEMIC HEALTH GOVERNMENT UTILITY	none, decontamination, segregation, sorting, recycle, decay	55 & 30 gallon steel drums, steel boxes
Dry Active Waste (Compactible) paper cloth clothing glassware plastic	COMMERCIAL ACADEMIC HEALTH GOVERNMENT UTILITY	compaction, incineration, segregation, sorting, decay	55 & 30 gallon steel drums, steel boxes, steel cargo vans, plastic boxes
Evaporator Concentrates	UTILITY	evaporation, solidification w/cement, polymers	55 gallon steel drums, steel liners
Cartridge Filters for Liquids	ACADEMIC UTILITY	none, dewatering, solidification w/cement, polymers	55 & 30 gallon steel drums, steel boxes, HIC
Granular/Fiber Filter Media for Liquids	COMMERCIAL UTILITY	dewatering to < 0.5% free water	55 gallon steel drums, steel liners, HIC
Activated Hardware control rods in-core instruments structural materials	ACADEMIC UTILITY	size reduction	55 gallon steel drums, steel liners, HIC
Contaminated Hardware	COMMERCIAL ACADEMIC HEALTH GOVERNMENT UTILITY	none, decontamination, decay	55 & 30 gallon steel drums, steel boxes
Ion Exchange Resins (Solidified)	COMMERCIAL UTILITY	solidification w/cement, polymers	55 gallon steel drums, steel liners, HIC
Ion Exchange Resins (Dewatered)	COMMERCIAL ACADEMIC UTILITY	dewatering to < 0.5% free water	55 gallon steel drums, steel liners, HIC

TABLE 1, continued

Typical LLW Categories Treatment and Packaging

Waste Category Type	Generator Categories Typically Producing Waste	Typical Treatment Used	Container Types Usec For Storage or Disposal
Contaminated Aqueous Liquids	COMMERCIAL ACADEMIC HEALTH GOVERNMENT	incineration, decay, sewerage disposal (see note 5)	55 & 30 gallon steel drums
Contaminated Oils	COMMERCIAL UTILITY	incineration, solidification, absorption	55 & 30 gallon steel drums, steel liners
Other Contaminated Organic Liquids	COMMERCIAL ACADEMIC HEALTH GOVERNMENT UTILITY	incineration, decay	Incinerated or stored in: 55 & 30 gallon steel drums
Contaminated Rubble, Soil, Sand, etc.	COMMERCIAL ACADEMIC	none	55 & 30 gallon steel drums, steel boxes, HIC
Other Sludge	COMMERCIAL UTILITY	dewatering to < 0.5% free water, incineration	55 & 30 gallon steel drums, steel boxes, HIC
Biological Waste carcasses tissue	COMMERCIAL ACADEMIC HEALTH	incineration, double containers with absorbents and lime	55 & 30 gallon steel drums, steel boxes, HIC
Depleted Uranium Sludges and Metals	COMMERCIAL	recycling, solidification	55 gallon steel drums, steel boxes

Notes:

(1) HIC means high integrity container, designed to withstand the effects of disposal for a minimum of 300 years.

(2) Not all waste streams, processes, or containers appear in a given year or from a specified generator category each year.

(3) "Steel liners" are typically large cylindrical vessels ranging in size from 50 to 215 cubic feet capacity.

(4) Other containers used less frequently include small steel pails or cans in the 1/2 to 5 gallon size and 9 to 10 cubic feet fiber drums used as temporary containment vessels prior to processing such as incineration where the fiber drum is incinerated also.

(5) The regulations of the U.S. Nuclear Regulatory Commission permit minute quantities and concentrations of certain radionuclides to be discharged into sanitary sewerage systems.

Low-Level Radioactive Waste Characteristics

General Information

Information is provided in this section on characteristics of LLW produced and managed in Massachusetts in 1989. Data for volume and total radioactivity are typically summarized by categories of interest, such as generator category or physical waste-form. Wastes packaged and shipped for disposal to licensed disposal facilities, as well as wastes stored for decay and wastes managed in other ways are tabulated. Mixed waste, which is LLW that also possesses hazardous waste characteristics as defined by the U.S. Environmental Protection Agency, is also briefly described.

Data presented in the following tables and graphs have been rounded for convenience of presentation. As a result, totals may not always precisely agree from table to table due to rounding errors. In addition, the number of significant figures are not consistently presented in order to illustrate the presence of small quantities, where rounding to the appropriate significant figure would have indicated that no waste was produced.

The 1989 data should not necessarily be considered "representative" for any one generator of LLW or any one year's total. For example, waste volumes have been decreasing significantly for several years. Also, volumes and activities may vary significantly from year to year, especially for some radioactive materials users. The data included in Figure 1 illustrate some of the yearly variability that may be expected.

Summary of Survey Results

Tables 2 and 3 and Figures 2 - 4 summarize and illustrate some results of particular interest derived from the 1990 survey, including statistics on responses to the survey and LLW quantities and radioactivity shipped for disposal to licensed disposal facilities.

In addition, the 1990 survey requested information regarding user programs for waste minimization and ability to store LLW on-site if access is lost to existing disposal facilities. (Loss of access is a penalty allowed by the federal Low-Level Radioactive Waste Policy Amendments Act of 1985 if a state does not provide disposal capacity for its LLW generators by January 1, 1993.)

Survey responses indicated that 35 organizations have formal, written policies for waste minimization and that 127 organizations have informal or unwritten source or volume minimization policies. One hundred eight (108) radioactive materials users noted that they provide waste minimization training/education to their employees.

None of the LLW generators responding to the 1990 survey stated that they would encounter significant difficulties in providing storage for LLW when access to disposal facilities is suspended after 1992. However, 37 generators indicated that they would have to increase storage capacity beyond existing capabilities, and indicated they would be able to do so, when loss of access occurs. This information was requested to enable the Management Board to provide assistance to generators as they prepare license amendments and plan for additional storage.

TABLE 2

Number of Radioactive Materials Users Reporting and Shipping Waste for Disposal in 1989

SURVEY PARAMETERs	**GENERATOR CATEGORY**					
	COMM	ACAD	HEAL	GOVT	UTIL	**TOTAL**
Number Reporting in 1990	257	40	111	19	2	429
Number Shipping for Disposal	50	18	17	2	2	89
% of Total Reporting Shipping for Disposal	19	45	15	11	100	21

TABLE 3

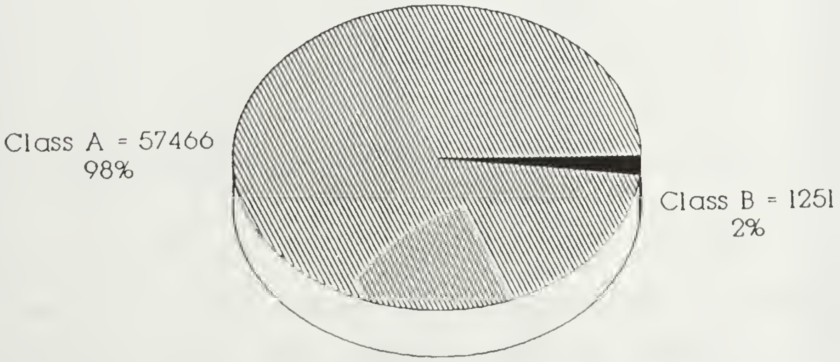
Summary of 1989 LLW Shipped for Disposal

Waste Generator Category	Volumes by Disposal Class (cubic feet)					Total Activity	
	Class A	Class B	Class C	Total[1]	% of Total	Curies	% of Total
COMMERCIAL	35,852	98	0	35,950	61	56,853	99
ACADEMIC	2,407	0	0	2,407	4	14	0
HEALTH	2,113	4	0	2,117	4	13	0
GOVERNMENT	609	0	0	609	1	12	0
UTILITY	16,485	1,149	0	17,634	30	300	1
TOTAL	57,466	1,251	0	58,717	100	57,192	100
% of Total	98	2	0	100		100	0

[1] Totals may not compare to totals published by others due to differences in reporting, broker treatment not reported by radioactive materials users, and end-of-the-year 1990 shipments credited by disposal sites to 1991.

FIGURE 2

1989 LLW Volume Shipped
By Disposal Class
(in cubic feet)



(No Class C Waste Shipped For Disposal)

FIGURE 3

1989 LLW Volume Shipped By Generator Category (in cubic feet)

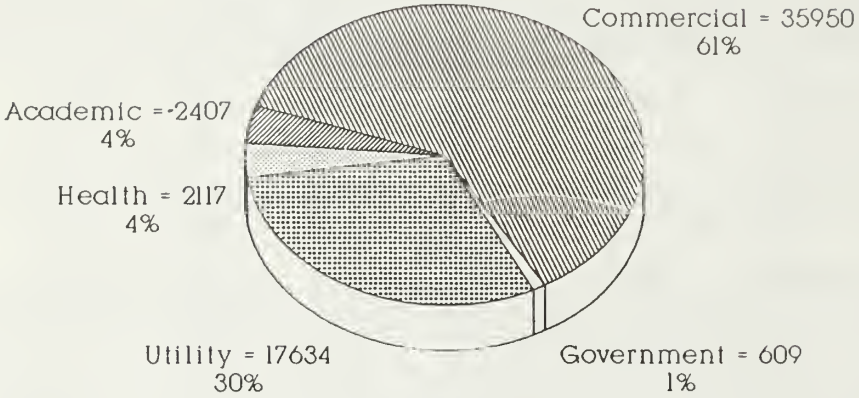
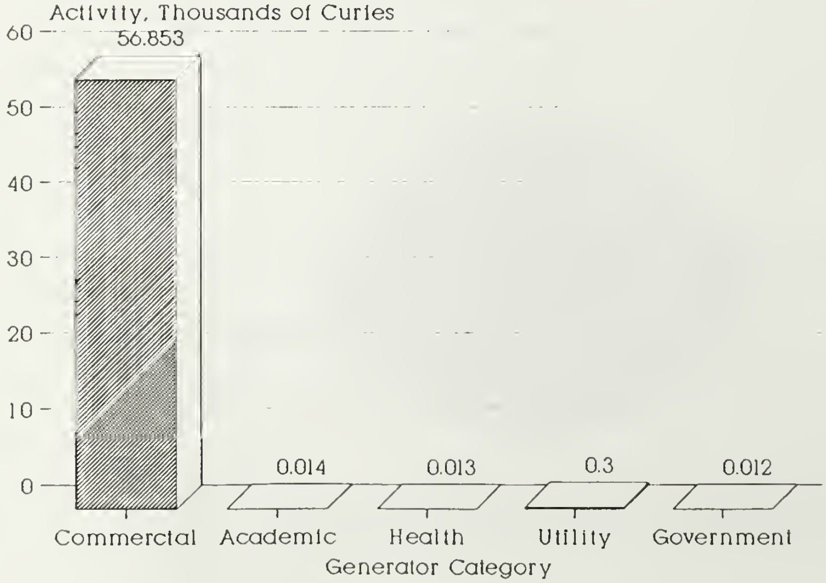


FIGURE 4

1989 LLW Activity Shipped By Generator Category (in curies)



1989 Low-Level Radioactive Waste Characterization Data

LLW characteristics for 1989 can be described from the 1990 survey in terms of the quantities produced and their physical and chemical type; sources, radiological nature, minimization, treatment, and packaging techniques employed; and the quantities ultimately shipped, disposed of, and managed in various ways other than disposal.

Quantities of Waste Generated in 1989

LLW quantities initially produced by radioactive materials users frequently exceed those quantities finally packaged or prepared for off-site disposal. Various approved treatment and packaging techniques are typically used which yield substantially reduced quantities prior to disposal, or even eliminate them entirely as disposable wastes. This section illustrates the quantities of waste produced in 1989 prior to processing for disposal.

TABLE 4

1989 LLW Volume Produced Prior to Processing
By Disposal Class
(in cubic feet)

WASTE CLASS	GENERATOR CATEGORY					TOTAL
	COMM	ACAD	HEAL	GOVT	UTIL	
A UNSTABLE	55090	17142	16015	361	33949	122,557
A STABLE	775	0	1	234	3264	4,274
B	113	0	[illegible]	0	1149	1,266
C	0	0	0	0	127	127
GTCC	1	0	0	0	0	1
OTHER[1]	13643	907	5546	22	0	20,118
MIXED	11487	1185	1475	0	158	14,305
TOTAL	81,110	19,234	23,041	617	38,646	162,648
% of Total	50	12	14	0	24	100

[1] Other waste includes waste stored for decay, minimally contaminated waste suitable by federal regulation for sewerage disposal, and waste which is otherwise deregulated due to minimal quantities of certain radionuclides and which may be managed by methods such as incineration.

TABLE 5

1989 LLW Volume Produced Prior to Processing By Waste Type and Generator Category (in cubic feet)

WASTE TYPE	GENERATOR CATEGORY					TOTAL
	COMM	ACAD	HEAL	GOVT	UTIL	
LIQUIDS	10115	3812	4352	0	4776	23,055
WET SOLIDS	873	2145	837	0	4541	8,396
SOLIDS	70121	13277	17852	617	29330	131,197
GAS	1	0	0	0	0	1
TOTAL	81,110	19,234	23,041	617	38,647	162,649
% of Total	50	12	14	0	24	100

Note: Free liquids are not shipped for disposal. The classification as "liquids" refers to the original waste-form prior to packaging for disposal. Liquids intended for disposal are immobilized by treatment processes such as absorption or solidification. Wet solids are dewatered to less than 0.5% free liquids or otherwise solidified or packaged with excess absorbents and/or additional packaging materials.

Results of Various Processing Methods on Waste Produced in 1989

The wastes produced in 1989 were processed and managed in various ways with the results shown in Table 6. Table 6 data are included only to illustrate the impact of process techniques on the original LLW quantities produced by radioactive materials users. Note that, if totaled, final waste quantities shown in this table may not equal those presented in the other sections of this report due to some inconsistencies in completing the surveys and in assigning treatment results and quantities to 1989. Actual final volumes for 1989 wastes are more accurately reflected in the following sections on waste quantities shipped for off-site disposal in 1989.

TABLE 6

1989 LLW Treatment Results
(volumes in cubic feet)

GENERATOR CATEGORY/(Number of Generators) and Process Factors	TREATMENT METHODS								
	Store for Decay	Compact	Super Compact	Incin-erate	Decont-aminate	Transfer to Broker to Process	Return to Vendor	Recycle or Recover	Other
COMMERCIAL/(78)									
No. Using	42	16	1	5	4	34	3	1	1
% of COMM	94	21	1	6	5	44	4	1	1
Initial Volume	22469	4833	NA	30	1880	4074	NA	NA	[illegible]
Final Volume	688	2625	NA	0	694	1583	NA	NA	0
VR Factor[1]	33	2		#	3	3			#
ACADEMIC/(31)									
No. Using	29	11	0	[illegible]	0	14	0	0	0
% of ACAD	94	35	0	13	0	45	0	0	0
Initial Volume	10063	6333		2735		NA			
Final Volume	503	1198		53		NA			
VR Factor	20	5		52					
HEALTH/(95)									
No. Using	62	8	0	8	0	8	26	1	0
% of HEAL	65	8	0	8	0	8	27	1	0
Initial Volume	9509	1920		1659		754	189	NA	
Final Volume	65	508		123		0	0	NA	
VR Factor	146	4		13		#	#		
GOVERNMENT/(3)									
No. Using	1	0	0	1	0	0	0	0	0
% of Govt	33	0	0	1	0	0	0	0	0
Initial Volume	21	0		181					
Final Volume	0	0		100					
VR Factor	#			2					

TABLE 6, continued

1989 LLW Treatment Results
(volumes in cubic feet)

GENERATOR CATEGORY/(Number of Generators) and Process Factors	TREATMENT METHODS								
	Store for Decay	Compact	Super Compact	Incin- erate	Decont- aminate	Transfer to Broker to Process	Return to Vendor	Recycle or Recover	Other
UTILITY/(2)									
No. Using	0	0	0	0	0	2	0	0	0
% of UTIL	0	0	0	0	0	100	0	0	0
Initial Volume	0	0				11550			
Final Volume	0	0				5775			
VR Factor						2			
TOTAL									
No. Using	141	35	1	18	4	58	29	2	1
% All Generator	67	17	0	9	2	28	14	1	0
Initial Volume	42062	13086	NA	4605	1880	17132	189	NA	NA
Final Volume	1256	4331	NA	276	694	7358	0	NA	NA
VR Factor	33	3		17	3	2			

Note: NA = not available; # = complete reduction

[1] VR Factor means "volume reduction factor" and is equal to the ratio of the original volume to the final volume after treatment.

1989 LLW Quantities Shipped Off-Site for Disposal

A portion of the LLW produced is packaged for disposal at licensed LLW disposal facilities. Tables 7 - 14 provide data from the 1990 survey that characterize this LLW.

Tables 10 - 14 list radionuclides utilized by radioactive materials users and the quantities of each radionuclide shipped for disposal in 1989. These tables also separate radionuclides by half-life groupings and generator category. This type of information may be useful for certain policy and facility development purposes, such as generator category cost/benefit analyses, evaluation of actual quantities of radioactivity requiring disposal and evaluation of portions of the total LLW stream which can be managed by other means, such as storage for decay.

TABLE 7

1989 LLW Volume Shipped for Disposal By Disposal Class and Generator Category (in cubic feet)

DISPOSAL CLASS	GENERATOR CATEGORY					TOTAL	% of Total
	COMM	ACAD	HEAL	GOVT	UTIL		
A UNSTABLE*	34959	2407	2111	375	13220	53,072	90
A STABLE*	893	0	1	234	3264	4,392	7
B	98	0	4	0	1149	1,251	2
C	0	0	0	0	0	0	0
TOTAL	35,950	2,407	2,116	609	17,633	58,715	100
. % of Total	61	4	4	1	30	100	0

* The distinction between Class A stable and Class A unstable waste is made for purposes of classifying LLW for certain land disposal technologies, including those currently employed at existing LLW disposal facilities. Class A waste is not required to meet the long-term, physical waste-form stability requirements specified in the regulations for Class B and Class C waste. Therefore, Class A waste generally cannot be disposed of with Class B and C waste. However, Class A waste that meets the waste-form stability requirement can be disposed of in a Class B or Class C disposal unit.

TABLE 8

1989 LLW Volume Shipped for Disposal By Waste Type and Generator Category (in cubic feet)

WASTE TYPE	GENERATOR CATEGORY					TOTAL	% of Total
	COMM	ACAD	HEAL	GOVT	UTIL		
LIQUIDS	7133	162	22	0	0	7,317	12
WET SOLIDS	189	5	44	0	4414	4,652	8
SOLIDS	28628	2240	2050	609	13220	46,747	80
GAS	0	0	0	0	0	0	0
TOTAL	35,950	2,407	2,116	609	17,634	58,716	100
% of Total	61	4	4	1	30	100	0

Note: Free liquids are not shipped for disposal. The classification as "liquids" refers to the original waste-form prior to packaging for disposal. Liquids intended for disposal are immobilized by treatment processes such as absorption or solidification. Wet solids are dewatered to less than 0.5% free liquids or otherwise solidified or packaged with excess absorbents and/or additional packaging materials.

TABLE 9

Radioactivity of 1989 LLW Shipped for Disposal By Generator Category (in curies)

	GENERATOR CATEGORY					
	COMM	ACAD	HEAL	GOVT	UTIL	TOTAL
Activity	56,853	14	13	12	300	57,192
% of Total	99	0	0	0	1	100

TABLE 10

Radioactivity of 1989 LLW Shipped for Disposal By Generator Category (in curies)

Radionuclides with Half-Lives < 20 Days

RADIO-NUCLIDE	HALF-LIFE[1]	GENERATOR CATEGORY					TOTAL
		COMM	ACAD	HEAL	GOVT	UTIL	
Ac-228	6.13h						0.0000
Ag-108	2.37m						0.0000
Am-244	10.1h						0.0000
Ag-108	2.76d			.000001			0.0000
Ba-131	11.8d						0.0000
Ba-140	12.7d					.0716	0.0716
Cd-115	53.5h	.000003					0.0000
Cs-132	6.475d						0.0000
Dy-165	2.334h		.000001				0.0000
Ga-67	72.3h	.076		.0002			0.0762
Ga-68	68m	.076					0.0000
Gd-159	18.6h						0.0000
In-111	2.83d	.017		.001			0.0080
In-113m	1.66h						0.0000
I-123	13.2h						0.0000
I-131	8.04d						0.0000
Ba-140	40.27h					.0716	0.0716
Mn-56	2.58h						0.0000
Mo-99	66h	.005					0.0000
Na-24	15.02h						0.0000
Ni-57	36.08h						0.0000
Ni-65	2.52h						0.0000

TABLE 10, continued

Radioactivity of 1989 LLW Shipped for Disposal
By Generator Category
(in curies)

Radionuclides with Half-Lives < 20 Days

RADIO-NUCLIDE	HALF-LIFE[1]	GENERATOR CATEGORY					TOTAL
		COMM	ACAD	HEAL	GOVT	UTIL	
Os-191	15.4d			.0021			0.0021
Y-90	14.28d	2.43729	1.14986	.818326			4.4053
Pb-201	9.4h						0.2030
Pb-203	52.05h	.003					0.2030
Pm-147	12m	.0632	.003010				0.0662
Rb-86	18.66d	.148	.013456	.000987			0.1623
Re-186	90.64h						0.0000
Sn-117m	13.61d						0.0000
Tc-99m	6h	.007				.172	0.2030
Pb-201	3.044d	.086					0.0860
Tl-202	12.23d	449.0					449.0000
V-48	16.24d						0.0000
Xe-133	5.245d						0.0000
Y-90	69h	.001					0.0010
Zn-69	57m	.007					0.0000
TOTAL		451.88	1.17	0.82	0.00	0.32	454.1823
% of Total		99.49	0.26	0.18	0.00	0.07	100.0000

[1] m = minutes; h = hours; d = days; y = years

TABLE 11

Radioactivity of 1989 LLW Shipped for Disposal By Generator Category (in curies)

Radionuclides with Half-Lives > 20 Days and < 90 Days

RADIO-NUCLIDE	HALF-LIFE (days)	GENERATOR CATEGORY					TOTAL
		COMM	ACAD	HEAL	GOVT	UTIL	
Be-7	53.28d	.013					0.0130
Cr-51	27.70d	.847870	.070070	.044858		11.1	12.0626
Ce-141	32.50d	.029	.001043				0.0130
Co-56	78.76d						0.0630
Co-58	70.8d	.016		.000001		9.75	9.7660
Fe-59	44.53d	.112	.000200	.000011			0.1122
Hg-203	46.6d	.013	.070078	.0001			0.2181
I-125	60.14d	4.28191	1.24727	8.77555			14.3046
In-114m	49.51d	.061	.001028	.001			0.0630
Ir-192	74.02d	.013		1.10370			1.1167
Nb-95	35.15d	.047	.001028			.107	0.1550
P-33	25.3d	.003					0.0030
Pu-237	45.3d						0.0000
Ru-103	39.28d	.036	.001063				0.0370
S-35	87.2d	131.350	1.48411	.351943			133.1860
Sb-124	87.2d	.005					0.0050
Sc-46	83.83d	.022	.001045	.000543			0.0236
Sr-85	64.84d	.047	.001043	.001252			0.0112
Yb-169	32.01d	.005					0.0050
Y-91	58.51d						0.0630
Zr-95	63.98d	.023					0.0230
TOTAL		137.09	2.81	10.28	0.00	20.96	171.1349
% of Total		80.11	1.64	6.01	0.00	12.25	100.0000

TABLE 12

Radioactivity of 1989 LLW Shipped for Disposal By Generator Category (in curies)

Radionuclides with Half-Lives > 90 Days and < 180 Days

RADIO-NUCLIDE	HALF-LIFE (days)	GENERATOR CATEGORY					TOTAL
		COMM	ACAD	HEAL	GOVT	UTIL	
Ca-45	163d	.705561	.092500	.005847			0.8038
Ce-139	137.7d		.000001				0.0000
Cm-242	162.8d					.000303	0.0003
Dy-159	144.4d						0.0000
Po-208	138.4d						0.0000
Se-75	119.8d	.023000	.000002				0.0230
Sn-113	115.1d	.138000	.002043	.004142			0.1441
Sn-123	129.2d						0.0030
Ta-182	115d						0.0030
Te-123m	119.7d						0.0000
Tm-170	106.6d						0.0000
Y-88	106.6d	.023000					0.0030
TOTAL		0.87	0.09	0.01	0.00	0.00	0.9700
% of Total		89.69	9.28	1.03	0.00	0.00	100.0000

TABLE 13

Radioactivity of 1989 LLW Shipped for Disposal
By Generator Category
(in curies)

Radionuclides with Half-Lives > 180 Days and < 5 Years

RADIO-NUCLIDE	HALF-LIFE[1]	GENERATOR CATEGORY					TOTAL
		COMM	ACAD	HEAL	GOVT	UTIL	
Ag-110m	249.9d	.010100	.000[illegible]0				0.030[illegible]
Au-195	183d	.028000					0.0[illegible]80
Cd-109	464d	.158220	.001010	.003310			0.1625
Ce-144	284.3d	.005000	.002500				0.0075
Co-57	270.9d	2.65743	.002045	.005998			2.6653
Cs-134	2.062y	.012200	.000001	.000100	.000001	5.78900	5.8013
Eu-155	4.96y	.002000					0.00[illegible]0
Fe-55	2.7y	.[illegible]2[illegible]000		.0000[illegible]4		53.9610	54.3850
Gd-153	242d	.[illegible][illegible]1000		.000780			0.1417
Ge-68	288d	.177000					0.1770
Mn-54	312.5d	.0[illegible]2000	.000004	.0007[illegible]0		8.20400	8.2760
Na-22	2.601y	.373000	.033828	.009137			0.4159
Pr-143	265d		.002500				0.[illegible]625
Pu-236	2.851y						0.0000
Ru-106	368d				.000001		0.0300
Sb-125	2.77y	.001000	.000004				0.00[illegible]0
Sm-145	340d						0.0000
Sn-119m	293d	.030000					0.0300
Tl-204	3.779y		.000505				0.000[illegible]
Tm-171	1.92y						0.0000
Zn-65	243.9d	.539000	.011006				0.[illegible][illegible]00
TOTAL		4.63	0.05	0.02	0.00	67.95	72.6500
% of Total		6.37	0.07	0.03	0.00	93.53	100.000

[1] d = days; y = years

TABLE 14

Radioactivity of 1989 LLW Shipped for Disposal By Generator Category (in curies)

Radionuclides with Half-Lives > 5 Years

RADIO-NUCLIDE	HALF-LIFE (yrs)	GENERATOR CATEGORY					TOTAL
		COMM	ACAD	HEAL	GOVT	UTIL	
Am-241	432.2						0.0000
Am-243	7380		.000000				0.0000
Cl-36	3010000	.128152	.021836	.005320			0.1552
Ba-133	10.74	.061000	.000150				0.0611
C-14	5730	114.611	.209737	.364257		.021000	115.2059
Co-60	5.271	1.74638	.004106	.000021		112.566	114.3164
Cs-137	30.17	.956000	.011681	.000127	.000002	79.5130	80.4807
Eu-152	13.33		.0000[illegible]0				0.0000
Eu-154	8.8	.002000					0.0020
H-3	12.46	55970.2767	9.14847	1.22935	8.70000	4.35980	55,993.7142
Ho-166m	1200						0.0000
I-129	1.59E+7	.007000				.001720	0.008[illegible]
Kr-85	10.72	1.11013	.00[illegible]000				1.1151
Nb-94	20300						0.0000
Ni-59	75000						0.0000
Pt-193	50						0.0000
Ni-63	96	2.22300	.151060	.000399	.280000	7.40800	10.0623
Pb-210	22.3		.016530				0.0165
Pu-241	14.4					.227000	0.2270
Pu-242	376300						0.0000
Ra-226	1600		.000201		.000186		0.0003
Sr-90	29.12	.014000	.025090			7.09100	7.1300
Th-232	1.41E+10	.000960	.005000				0.0059

TABLE 14, continued

Radioactivity of 1989 LLW Shipped for Disposal By Generator Category (in curies)

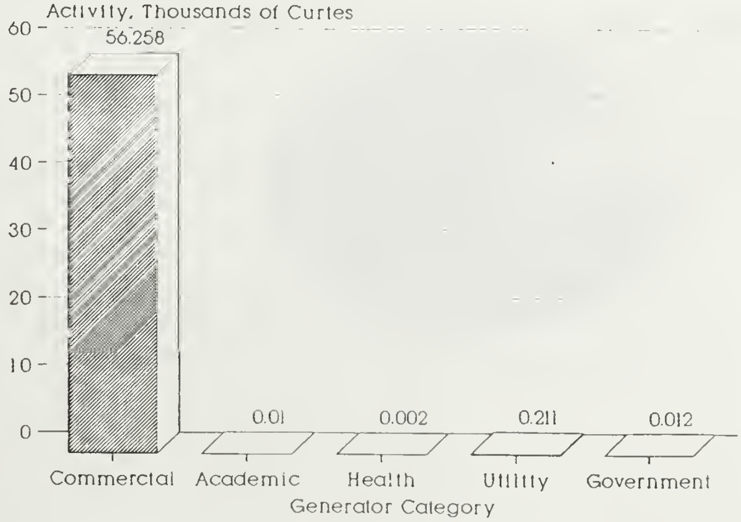
Radionuclides with Half-Lives > 5 Years

RADIO-NUCLIDE	HALF-LIFE (yrs)	GENERATOR CATEGORY					TOTAL
		COMM	ACAD	HEAL	GOVT	UTIL	
Tc-99	213000	.244000	.053180	.002000		.002500	0.3016
TRU	Various					.010700	0.0107
U-234	244500	.020000					0.0200
U-235	7.04E+8	.020000					0.0010
U-238	4.468E+9	166.820	.002500		3.35000		170.1725
TOTAL		56,258.2211	9.6540	1.6012	12.3301	211.2007	56,493.0071
% of Total		99.5800	0.0200	0.0000	0.0200	0.3700	100.0000

FIGURE 5

Radioactivity of 1989 LLW Shipped for Disposal By Generator Category (in curies)

Total of Radionuclides with Half-Lives > 5 Years



Other LLW Produced in 1989

Tables 15-17 summarize the quantities of discarded radioactive materials produced in 1989 which were managed by methods other than shipment to a licensed LLW disposal facility. These included management by decay, incineration, or sewerage discharge; and waste placed in storage, including "mixed" LLW/hazardous chemical wastes stored for future treatment and disposal.

Mixed waste must be stored on-site due to restrictions of the U.S. Environmental Protection Agency (EPA) on disposal of untreated hazardous wastes. Mixed waste is defined by the NRC and EPA as "waste that satisfies the definition of low-level radioactive waste (LLW) in the Low-Level Radioactive Waste Policy Amendments Act of 1985 and contains hazardous waste that either (1) is listed as a hazardous waste in Subpart D of 40 CFR 261 or (2) causes the LLW to exhibit any of the hazardous waste characteristics identified in Subpart C of 40 CFR Part 261."

Figure 6 is derived from Table 15, and illustrates quantities of mixed waste produced in Massachusetts in 1989, as reported by radioactive materials users. It should be noted that of the total mixed waste volume reported, 9,400 cubic feet is attributable to the decommissioning and cleanup of a single commercial facility.

FIGURE 6

1989 Mixed Waste Volumes
(in cubic feet)

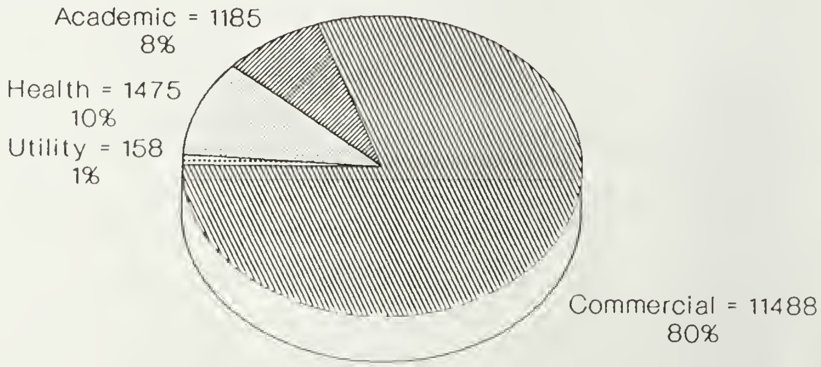


TABLE 15

1989 Mixed Waste Volumes
(in cubic feet)

MIXED WASTE TYPE		GENERATOR CATEGORY					
		COMM	ACAD	HEAL	GOVT	UTIL	TOTAL
Waste Form	Liquid	1639	1185	825	0	158	3,807
	Wet Solid	<1	0	9	0	0	10
	Solid	9848	0	641	0	0	10,489
	Gas	0	0	0	0	0	0
	Total	11,488	1,185	1,475	0	158	14,306
Waste Class	A	1241	1186	1504	0	158	14,089
	B	0	0	4	0	0	4
	C	43	0	0	0	0	43
	Other	165	0	0	0	0	165
Hazard Type	Ignitable	1276	990	689	0	143	3,098
	Corrosive	2	0	0	0	0	2
	Reactive	0	0	0	0	60	60
	EP Toxic	8500	0	0	0	128	8,628

Note: Subtotals and totals may not be comparable between groupings due to reporting inconsistencies and the fact that some quantities of waste may have been assigned multiple hazard categories.

TABLE 16

1989 Non-Classified Waste Volumes
(in cubic feet)

WASTE TYPE	GENERATOR CATEGORY					
	COMM	ACAD	HEAL	GOVT	UTIL	TOTAL
Liquid	441	872	2587	0	0	3,900
Wet Solid	301	<1	14	0	0	316
Solid	12901	35	2945	22	0	15,903
Gas	0	0	0	0	0	0
TOTAL	13,643	908	5,546	22	0	20,119

Note: These volumes generally reflect management by means other than LLW facility disposal, allowable by regulations of the U.S. Nuclear Regulatory Commission, such as storage for decay and sewerage disposal, as well as those that are classified as "deregulated" due to their low concentrations of certain radionuclides.

TABLE 17

Waste in Storage during 1989
(in cubic feet)

	GENERATOR CATEGORY					
	COMM	ACAD	HEAL	GOVT	UTIL	TOTAL
VOLUMES	14297	1939	104	<1	1708	18,049

Note: These wastes consist of those packaged and accumulated for disposal, mixed wastes stored until disposal is available, and wastes not yet processed or packaged prior to disposal.

LLW Quantity Projections for Future Years

The 1990 survey requested radioactive materials users to estimate waste volumes and total activity for the years 1990 through 1995. Their projections are summarized in Tables 18 and 19.

In addition, a four-year average was calculated for each radioactive materials user shipping waste in 1989, using the actual quantities shipped in 1989 and three years of projected data for the years 1990 - 1992. The four-year averages are listed in Table 20.

TABLE 18

Generator Volume Projections
(in cubic feet)

GENERATOR TYPE	YEAR					
	1990	1991	1992	1993	1994	1995
COMMERCIAL	24173	33728	20056	12138	10516	9750
ACADEMIC	2234	2697	2835	1684	1736	2095
HEALTH	2945	1434	1222	879	886	877
GOVERNMENT	1108	336	6	6	6	6
UTILITY	18810	18816	17005	17363	17105	17463
TOTAL	49,270.00	57,011.00	41,124.00	32,070.00	30,249.00	30,191.00

FIGURE 7

Generator Volume Projections
(in cubic feet)

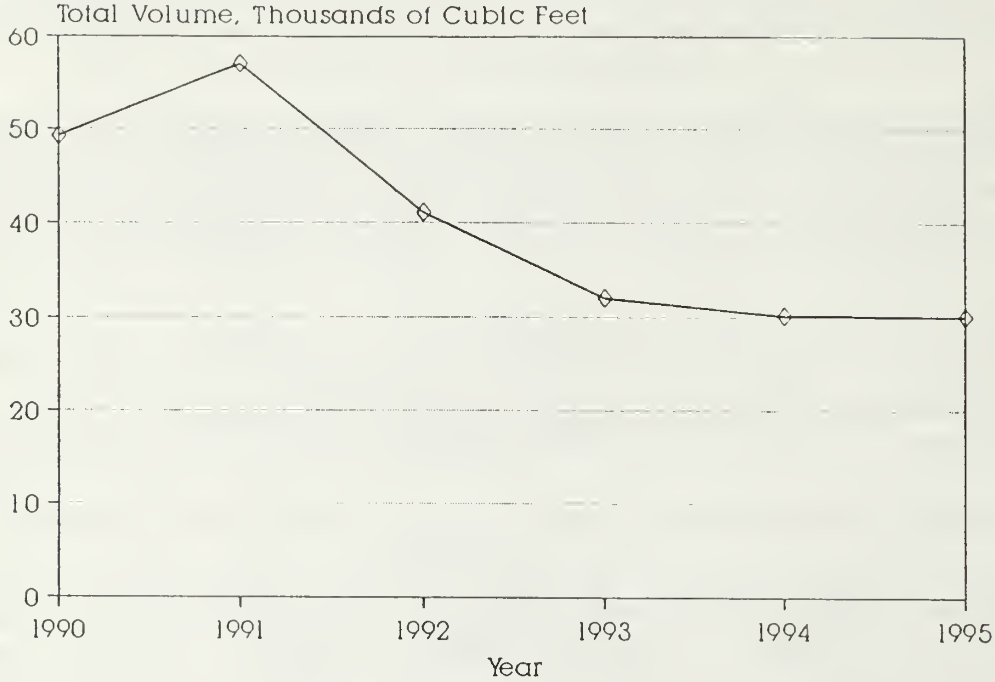


TABLE 19

Generator Activity Projections
(in curies)

GENERATOR TYPE	YEAR					
	1990	1991	1992	1993	1994	1995
COMM	110538	99574	87844	80921	72913	65658
ACAD	17	17	18	18	18	18
HEAL	8	5	3	4	4	4
GOVT	2	2	<1	<1	<1	<1
UTIL[1]	167763	57153	1003	39067	5003	39708
TOTAL	278,328	156,751	88,869	120,011	77,939	105,389

[1] Variations in utility activities are primarily due to the routine removal of irradiated reactor components which are packaged and shipped on an irregular schedule.

FIGURE 8

Generator Activity Projections
(in curies)

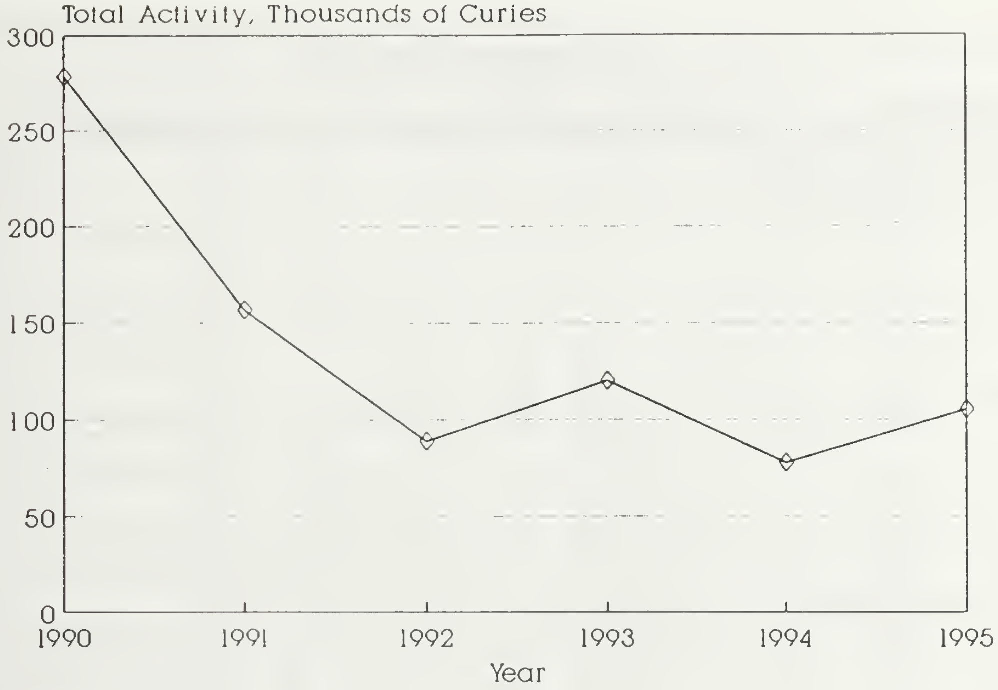


TABLE 20

Four-Year Averages
1989 Shipments and 1990-1992 Projections

ORGANIZATION	AVERAGE VOLUME (in cubic feet)				AVERAGE ACTIVITY (in curies)
	Class A	Class B	Class C	Total	
Boston Edison Co.	10301	1457	249	12,007	56424
Nuclear Metals, Inc.	10396			10,396	104
E.I. DuPont De Nemours and Co.	8614	167		8,781	88776
Yankee Atomic Electric Co.	5879		180	6,059	132
CIBA Corning Diagnostics (Walpole)	885			885	5.476
Massachusetts Insitute of Technology	725			725	1.802

TABLE 20

Four-Year Averages
1989 Shipments and 1990-1992 Projections

ORGANIZATION	AVERAGE VOLUME (in cubic feet)				AVERAGE ACTIVITY (in curies)
	Class A	Class B	Class C	Total	
Tufts University School of Medicine	688			688	1.060
Boston University Medical Center	541			541	0.599
U.S. Army, Materials Technology Lab.	504			504	1.910
Genetics Institute	469			469	2.212
Advanced Magnetics, Inc.	422			422	0.184
Seragen, Inc	400			400	0.084
New England Medical Center	379			379	0.394
Baxter Health Care Corp.	351			351	4.052
Smithkline Beecham Clinical Lab.	338			338	0,074
Vitek Systems	337			337	0.663
INS Corp.	253			253	0.967
Boston City Hospital	220			220	0.071
Cambridge Neuroscience Research	210			210	0.048
Amersham Corp.	195			195	1.497
BioTechnica International	151			151	0.050
Creative Biomolecules, Inc.	146			146	0.054
Organogenesis, Inc.	143			143	0.045
Brigham and Women's Hospital	135			135	0.051
University of Massachusetts at Amherst	132			132	0.264
Whitehead Institute for Biomedical Research	129			129	0.172
Marine Biological Laboratory	118			118	0.265
Boston College	116			116	0.029
Northeastern University	113			113	0.009
Springborn Laboratories, Inc.	103			103	0.013

TABLE 20

Four-Year Averages
1989 Shipments and 1990-1992 Projections

ORGANIZATION	AVERAGE VOLUME (in cubic feet)				AVERAGE ACTIVITY (in curies)
	Class A	Class B	Class C	Total	
Harvard University	100			100	0.123
Serono Laboratories	96			96	0.016
Woods Hole Oceanographic Institution	94			94	0.082
Collaborative Research, Inc.	89			89	0.061
Repligen Corp.	87			87	0.053
Brandeis University	84			84	8.473
Biogen, Inc.	84			84	0.053
USDA Nutrition Research Center	75			75	0.044
Abbott Biotech, Inc.	69			69	0.035
Massachusetts General Hospital	68			68	0/106
Boston University	59			59	0.046
T Cell Sciences	56			56	0.163
Cellcor Therapies	55			55	0.045
Arthur D. Little, Inc.	54			54	0.125
Crossfield and Receiver Protector Products	43			43	22
M/A-COM Microwave Components, Inc.	40.1			40	24.002
Metpath, Inc.	40			40	<.001
ImmuLogic Pharmaceutical Corp.	38			38	0.045
Alkermes, Inc.	37			37	0.017
Nissin Molecular Biology Institute	37			37	0.007
Tufts University	36			36	0.008
Beth Israel Hospital	36			36	0.017
Institute of Molecular Biology, Inc.	36			36	0.037
Dana-Farber Cancer Institute	36			36	0.073

TABLE 20

Four-Year Averages
1989 Shipments and 1990-1992 Projections

ORGANIZATION	AVERAGE VOLUME (in cubic feet)				AVERAGE ACTIVITY (in curies)
	Class A	Class B	Class C	Total	
PB Diagnostic Systems, Inc.	33			33	0.065
ENRM Veterans Hospital	32			32	0.036
Applied BioTechnology, Inc.	32			32	0.168
University of Lowell	31			31	0/011
Gene-Trak Systems	29			29	0.009
Eunice Kennedy Shriver Center for Mental Retardation	28			28	0.051
Boston V.A. Medical Center	28			28	0.007
Enzyme Center	27			27	0.100
Cambridge Biotech Corp.	26			26	0.058
Smith College	24			24	0.030
Penicillin Assays, Inc.	22			22	0.071
University of Massachusetts Medical Center	21			21	0.083
Massachusetts Eye & Ear Infirmary	18			18	0.006
Joslin Diabetes Center	15.6			16	0.903
Biomeasure, Inc.	15			15	0.100
Worcester Foundation for Experimental Biology	13			13	0.009
Children's Hospital	13			13	0.068
Somatix Corp.	12			12	0.006
North Adams Regional Hospital	11			11	0.001
Mallinckrodt Medical, Inc., Diagnostic Imaging Services	10			10	<.001
U.S. Health and Human Services, Food and Drug Administration	8			8	2.320
Amicon Division, W.R. Grace Co.	7.5			8	0.001
Framingham Union Hospital	7.5			8	<0.001

TABLE 20

Four-Year Averages
1989 Shipments and 1990-1992 Projections

ORGANIZATION	AVERAGE VOLUME (in cubic feet)				AVERAGE ACTIVITY (in curies)
	Class A	Class B	Class C	Total	
ImmunoGen, Inc.	7			7	<0.001
Imreg, Inc.	7			7	0.005
BIOTEK, Inc.	7			7	0.034
EG&G, Inc.	6			6	0.083
CIBA Corning Diagnostics (Bedford)	6			6	<0.001
Bard Vascular Systems Division, C. R. Bard, Inc.	5			5	0.002
New England Aquarium	4.01			4	<0.001
New England Deaconess Hospital	1.375	2.34		4	1.669
Williams College	4			4	0.009
Polaroid Corp.	2			2	0.270
Digital Equipment Corp. (Andover)	1			1	<1.000
Contraves-EO Div.	1			1	<0.001
TOTAL	45,357.09	1,626.34	429.00	47,414	145,711.67

Radioactive Materials Users Surveyed in 1990

Each radioactive materials user that responded to the 1990 survey is listed in this section. A breakdown of the radioactivity and volume by each LLW generator who shipped for disposal is included. Table 21 summarizes waste generation by county. Table 22 lists all survey respondents by county and community of origin to show the geographic distribution of radioactive materials users and LLW shipments in Massachusetts. Since 1989, a few radioactive materials users listed in Tabe 22 consolidated their operations or terminated their licenses. These changes will be accounted for in the 1991 survey report.

Table 21

1989 Volume and Radioactivity Shipped By County
as Reported by
Radioactive Materials Users Filing the 1990 Survey

County	Number of RAM Users	Number of Generators Shipping	Total Volume (cubic feet)	% of Total Volume	Total Activity (curies)	% of Total Activity
BARNSTABLE:	9	2	270	0.46	0.713	0.00
BERKSHIRE:	13	2	51	0.09	0.080	0.00
BRISTOL:	16	1	4	0.01	0.0002	0.00
DUKES	2	0	0	0.00	0	0.00
ESSEX	41	3	116	0.20	27.877	0.05
FRANKLIN	3	1	10515	17.91	17.829	0.03
HAMPDEN	21	1	432	0.74	2.207	0.00
HAMPSHIRE	6	2	226	0.38	0.390	0.00
MIDDLESEX·	176	45	26644	45.38	227.201	0.40
NORFOLK	42	6	1426	2.43	2.258	0.00
PLYMOUTH	18	3	7755	13.21	283.622	0.50
SUFFOLK	47	20	11218	19.11	56629.853	99.02
WORCESTER	35	3	60	0.10	0.144	0.00
TOTAL	429	89	58,717	100.02	57,192.174	100.00

TABLE 22

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
BARNSTABLE:						
Barnstable	Cape Cod Community College				0	
Falmouth	Falmouth Hospital				0	
Falmouth	Marine Biological Laboratory	120			120	.460
Falmouth	Marine Research, Inc.				0	
Falmouth	U.S. Department of the Interior, U.S. Geological Survey				0	
Falmouth	Woods Hole Oceanographic Institution	150			150	.2528327
Hyannis	Cape Cod Hospital				0	
Hyannis	Echo Cardiographic Laboratory, Philip N. Chiotellis, M.D.				0	
Sandwich	AGM Marine Contractors, Inc.				0	
Subtotal:		270	0	0	270	0.713
BERKSHIRE:						
Adams	Pfizer, Inc.				0	
Great Barrington	Fairview Hospital				0	
Lee	Capfilm, Inc.				0	
Lenox	Lenox Institute for Research, Inc.				0	
North Adams	North Adams Regional Hospital	44			44	.006
North Adams	Sprague Technologies, Inc.				0	
Pittsfield	A.H. Rice Corp.				0	
Pittsfield	Beloit Corp.-Research Center				0	
Pittsfield	Berkshire Medical Center				0	
Pittsfield	General Electric Aerospace				0	
Pittsfield	Hillcrest Hospital				0	
Pittsfield	J.H. Maxymillian, Inc.				0	
Williamstown	Williams College	6.5			7	.03415
Subtotal:		50.5			51	.080

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
BRISTOL:						
Attleboro	Sturdy Memorial Hospital				0	
Attleboro	Mallinckrodt Medical, Inc., Diagnostic Imaging Services	4.01			4	.0002
Attleboro	State Line Scrap Co.				0	
Dartmouth	Southeastern Massachusetts University				0	
Fall River	Charlton Memorial Hospital				0	
Fall River	Roentgen Associates of Fall River, Robert N. Semine, M.D.				0	
Fall River	St. Anne's Hospital				0	
Mansfield	Clinical Science Laboratory				0	
New Bedford	Ainsworth, Harry (M.D.)				0	
New Bedford	Dritz Corp.				0	
New Bedford	St. Luke's Hospital				0	
Norton	Wheaton College				0	
Raynham	Defeo, Wait & Associates, Inc.				0	
Raynham	Environmental Chem-Test Corp.				0	
Somerset	New England Power Co.				0	
Taunton	Morton Hospital & Medical Center, Inc.				0	
Subtotal:		**4.01**			**4**	**.0002**
DUKES:						
Oak Bluffs	Martha's Vineyard Hospital				0	
Vineyard Haven	Healy, Kent A. (P.E.)				0	
Subtotal:					**0**	**0**

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
ESSEX:						
Amesbury	Amesbury Hospital				0	
Andover	Carroll Engineers, Inc.				0	
Andover	Digital Equipment Corp.	0.54			1	<1.0
Andover	Eisai Research Institute				0	
Andover	Raytheon Co.				0	
Beverly	Beverly Hospital				0	
Beverly	Crossfield & Receiver Protector Products	107			107	26.87483
Beverly	New England Biolabs, Inc.				0	
Beverly	Salem and Beverly Water Supply Board				0	
Beverly	Stocker & Yale, Inc.				0	
Danvers	ABIOMED, Inc.				0	
Danvers	Amicon Division, W. R. Grace & Co.	7.5			8	.0023035
Danvers	Charles T. Morgan Co., Inc.				0	
Danvers	GTE Products Corp.				0	
Danvers	Hunt Center for Emergency and Ambulatory Care				0	
Gloucester	Addison Gilbert Hospital				0	
Gloucester	U.S. Deptartment of Commerce, National Marine Fisheries				0	
Haverhill	Hale Hospital				0	
Haverhill	IMI, Inc.				0	
Ipswich	Bio-Nuclear Measurements, Inc.				0	
Lawrence	Lawrence General Hospital				0	
Lawrence	MA Department of Environmental Protection Lawrence Experiment Station				0	
Lawrence	Silverman Brothers, Inc.				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
ESSEX, continued:						
Lynn	Atlanticare Medical Center				0	
Lynn	General Electric Aircraft Engines				0	
Marblehead	Enseco, Inc.				0	
Methuen	Holy Family Hospital				0	
Middleton	F. X. Masse Associates, Inc.				0	
Newburyport	Anna Jaques Hospital				0	
Newburyport	Genus, Inc.				0	
North Andover	AT&T Network Systems				0	
North Andover	Borden PIP				0	
North Andover	Brooks School				0	
North Andover	Mediq Imaging Services				0	
North Andover	RTS Technology, Inc.				0	
Peabody	J. B. Thomas Hospital				0	
Salem	MA Department of Fisheries, Wildlife, and Environmental Law Enforcement Cat Cove Marine Laboratory				0	
Salem	New England ChromaChem				0	
Salem	New England Power Co.				0	
Salem	Salem Hospital				0	
West Newbury	Women's HealthCare				0	
Subtotal:		115.04	0.00	0.00	116	27.877
FRANKLIN:						
Deerfield	John E. Cain Co.				0	
Greenfield	Franklin Medical Center				0	
Rowe	Yankee Atomic Electric Co.	10515			10515	17.829
Subtotal:		10515			10515	17.829

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
HAMPDEN:						
Chicopee	College of Our Lady of the Elms				0	
Chicopee	Environmental Testing Lab, Inc.				0	
Holyoke	Holyoke Hospital				0	
Holyoke	Providence Hospital				0	
Ludlow	F&J Construction Co. of Ludlow, Inc.				0	
Ludlow	Ludlow Hospital				0	
Palmer	Tambrands				0	
Palmer	Wing Memorial Hospital				0	
Springfield	Allied Testing Laboratories, Inc.				0	
Springfield	Baystate Medical Center				0	
Springfield	Cameo Diagnostic Centre, Inc.				0	
Springfield	INS Corp.	432.4			432	2.207
Springfield	Johnson Foils, Inc.				0	
Springfield	Mercy Hospital				0	
Springfield	Monsanto Chemical Co.				0	
Springfield	Polysar, Inc.				0	
Springfield	Springfield Regional Waste Water Treatment Plant				0	
Springfield	Springfield Technical Community College				0	
Westfield	Noble Hospital				0	
Westfield	Springfield Municipal Water Works				0	
Westfield	Tighe & Bond, Inc.				0	
Subtotal:		432.4			432	2.207

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
HAMPSHIRE:						
Amherst	Amherst College				0	
Amherst	University of Massachusetts at Amherst	154.35			154	.3082
Northhampton	Smith College	72.1			72	.0821652
Northhampton	Cooley Dickinson Hospital				0	
Northhampton	V. A. Medical Center				0	
South Hadley	Mount Holyoke College				0	
Subtotal:		226.45			226	.390
MIDDLESEX:						
Acton	ENSR Consulting and Engineering				0	
Arlington	Choat-Symmes Health Services, Inc.				0	
Ashland	Fenwal, Inc.				0	
Ayer	Nashoba Community Hospital				0	
Bedford	CIS-US, Inc.				0	
Bedford	Collaborative Research, Inc.	232			232	.23558
Bedford	ENRM Veterans Hospital	37.5			38	.050241
Bedford	ESA Laboratories, Inc.				0	
Bedford	MIE, Inc.				0	
Bedford	Millipore Corp.				0	
Bedford	Spire Corp.				0	
Billerica	Aeonic Systems, Inc.				0	
Billerica	Bard Vascular Systems Division, C.R. Bard, Inc.	14.8			15	.005144
Billerica	Inframetrics, Inc.				0	
Burlington	Amersham Corp.	278			278	.989
Burlington	Calibration Technology, Inc.				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

		Volume (in cubic feet)				Activity (in curies)
County/Town	Organization	Class A	Class B	Class C	Total	
MIDDLESEX, continued:						
Burlington	Ion Trak Instruments, Inc.				0	
Burlington	Lahey Clinic Medical Center				0	
Burlington	M/A-COM Microwave Components, Inc.	40.1			40	24.00228
Burlington	Milligen/BioSearch				0	
Burlington	Raytheon Service Co.				0	
Burlington	Scinticor, Inc.				0	
Burlington	Solid State Testing, Inc.				0	
Burlington	Visidyne, Inc.				0	
Cambridge	Advanced Magnetics, Inc.	337.5			338	.17702
Cambridge	Alkermes, Inc.	28			28	.048
Cambridge	American Science & Engineering, Inc.				0	
Cambridge	Applied BioTechnology, Inc.	37.5			38	.195
Cambridge	Arthur D. Little, Inc.	133			133	.33
Cambridge	BASF Bioresearch Corporation				0	
Cambridge	Baxter Healthcare Corporation	221.81			222	7.706
Cambridge	Biogen, Inc.	180			180	.163
Cambridge	Bioran Medical Laboratory				0	
Cambridge	BioSurface Technology, Inc.				0	
Cambridge	Biotechnica Diagnostics, Inc.				0	
Cambridge	BioTechnica International	82.5			83	.064685
Cambridge	Bolton, M.M. Galanek, M.S.				0	
Cambridge	Cambridge Hospital				0	
Cambridge	Cambridge Neuroscience Research	88.59			89	.083321
Cambridge	Camp Dresser & McKee Laboratory Services				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
MIDDLESEX, continued:						
Cambridge	Charles Stark Draper Laboratory, Inc.				0	
Cambridge	Digital Scintigraphics, Inc.				0	
Cambridge	Enseco - Erco Laboratory				0	
Cambridge	Enzytech, Inc.				0	
Cambridge	Genetics Institute	187.5			188	1.5162
Cambridge	Genzyme Corp.				0	
Cambridge	Haley & Aldrich, Inc.				0	
Cambridge	Harvard University	191			191	.241842
Cambridge	ImmuLogic Pharmaceutical, Corp.	18			18	.0301
Cambridge	ImmunoGen, Inc.	9			9	.000732
Cambridge	Imreg, Inc.	19			19	.020601
Cambridge	International Biotechnology Laboratories, Inc.				0	
Cambridge	MANLABS, Division of Alcan Aluminum Corp.				0	
Cambridge	Massachusetts Insitute of Technology	570			570	.856366
Cambridge	Matritech, Inc.				0	
Cambridge	Metpath, Inc.	48			48	.0003
Cambridge	Mount Auburn Hospital				0	
Cambridge	Organogenesis, Inc.	120			120	.135
Cambridge	Procept, Inc.				0	
Cambridge	Protein Engineering Corp.				0	
Cambridge	Repligen Corp.	37.5			38	.0197478
Cambridge	Sancta Maria Hospital				0	
Cambridge	SEA Consultants, Inc.				0	
Cambridge	Somatix Corp.	8			8	.0019

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
MIDDLESEX, continued:						
Cambridge	T Cell Sciences, Inc.	72.05			72	.3
Cambridge	Transkaryotic Therapies, Inc.				0	
Cambridge	TRW Fasteners Division				0	
Cambridge	U.S. Department of Transportation Volpe National Transportation Systems Center				0	
Cambridge	Vertex Pharmaceuticals, Inc.				0	
Cambridge	Whitehead Institute for Biomedical Research	112.5			113	.187003
Concord	Nuclear Metals, Inc.	21363.2			21,363	165.834
Concord	Oxford Analytical	.			0	
Concord	Emerson Hospital				0	
Dracut	United Circuits, Inc.				0	
Everett	M&S Metals Co., Inc.				0	
Everett	Textron Research Laboratory				0	
Everett	Whidden Memorial Hospital				0	
Framingham	Avery Dennison				0	
Framingham	Dositec, Inc.				0	
Framingham	Framingham Union Hospital	7.5			8	.00045
Framingham	Gene-Trak Systems	35.25			35	.0124
Framingham	Massachusetts Civil Defense Agency				0	
Holliston	Axton-Cross Co., Inc.				0	
Hopkinton	Biomeasure, Inc.	15			15	.101
Hopkinton	Creative Biomolecules, Inc.	183.5			184	.064
Hopkinton	Liberty Mutual Insurance Co.				0	
Hopkinton	Seragen, Inc	388			388	.0375
Hudson	Digital Equipment Corp.				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
MIDDLESEX, continued:						
Lexington	Instrumentation Laboratory				0	
Lexington	Interneuron Pharmaceuticals, Inc.				0	
Lexington	Kendall Co.				0	
Lexington	Loral Infrared & Imaging Systems, Inc.				0	
Lexington	Raytheon Co.				0	
Lexington	W. R. Grace and Co., Research Division				0	
Lexington	U.S. Environmental Protection Agency				0	
Littleton	Littleton Light & Water Dept.				0	
Lowell	Lowell General Hospital				0	
Lowell	Multi-Core, Inc.				0	
Lowell	Raytheon Co.				0	
Lowell	St. John's Hospital				0	
Lowell	St. Joseph's Hospital				0	
Lowell	Textron Specialty Materials				0	
Lowell	University of Lowell	80			80	.01405
Malden	Enzyme Center	45			45	.1
Malden	Maiden Hospital				0	
Malden	Penicillin Assays, Inc.	30			30	.06
Marlborough	Contraves-EO Div.	.7			1	.00096
Marlborough	Design Pak, Inc.				0	
Marlborough	Marlborough Hospital				0	
Marlborough	Sepracor, Inc.				0	
Maynard	AdvaCare Diagnostic				0	
Medford	Gaeta, Neil A.				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
MIDDLESEX, continued:						
Medford	Lawrencê Memorial Hospital of Medford				0	
Medford	Tufts University	30.6			31	.00567
Melrose	Melrose Wakefield Hospital				0	
Natick	Conam Inspection, Inc., Arnold Greene Testing Labs.				0	
Natick	EG&G Berthold				0	
Natick	Leonard Morse Hospital				0	
Natick	MODAR, Inc.				0	
Natick	Research Biochemicals, Inc.				0	
Natick	U.S. Army, Natick Research, Development and Engineering Center				0	
Newton	Biotechnology Development Corp.				0	
Newton	Boston College	112.6			113	.031691
Newton	Cellcor Therapies, Inc.	43.09			43	.031706
Newton	David Gordon Associates, Inc.				0	
Newton	GZA GeoEnvironmental, Inc.				0	
Newton	HNU Systems, Inc.				0	
Newton	Hygeia Sciences				0	
Newton	MA Department of Labor and Industries				0	
Newton	Newton-Wellesley Hospital				0	
Newton	Trow Protze Consulting Engineers				0	
Somerville	Somerville Hospital				0	
Somerville	Vicam				0	
Stoneham	CHEM Shared Services, Inc., Center for Radiation Oncology				0	
Stoneham	VTS of Massachusetts, Inc.				0	
Stoneham	New England Memorial Hospital				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
MIDDLESEX, continued:						
Stow	E.T. & L Construction Corp.				0	
Sudbury	Medical and Scientific Enterprises, Inc.				0	
Sudbury	Raytheon Co., Equipment Development Labs.				0	
Waltham	Betagen Corp.				0	
Waltham	Brandeis University	127.5			128	9.89
Waltham	Eunice Kennedy Shriver Center for Mental Retardation	2.8			3	.102019
Waltham	GTE Laboratories, Inc.				0	
Waltham	MA Metropolitan District Commission				0	
Waltham	Panametrics, Inc.				0	
Waltham	Polaroid Corp.	8.69			9	1.081735
Waltham	Raytheon Co., Equipment Manufacturing Division				0	
Waltham	Raytheon Co., Microwave & Power Tube Division				0	
Waltham	Smithkline Beecham Clinical Lab	450			450	.121
Waltham	Teledyne Engineering Services				0	
Waltham	TGM Detectors, Inc.				0	
Waltham	Thermo Electron Technologies				0	
Waltham	TMA Skinner & Sherman				0	
Waltham	U.S. Army Corps of Engineers				0	
Waltham	Waltham/Weston Hospital and Medical Center				0	
Watertown	Doble Engineering Company				0	
Watertown	Radiation Monitoring Devices, Inc.				0	
Watertown	U.S. Army, Materials Technology Laboratory	586.7			587	3.35
Wayland	Raytheon Co., Equipment Division				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
MIDDLESEX, continued:						
Westford	Courier Westford				0	
Wilmington	Altron, Inc.				0	
Wilmington	New England Pathology Services				0	
Wilmington	Textron Defense Systems				0	
Winchester	GEI Consultants, Inc.				0	
Winchester	U.S. Department of Health and Human Services Food and Drug Administration	22.5			23	8.980190
Winchester	Winchester Hospital				0	
Woburn	Biotechnology Management Association, Inc.				0	
Woburn	BIOTEK, Inc.	7.5			8	.0245
Woburn	Crystal Diagnostics, Inc.				0	
Woburn	Gentest Corp.				0	
Woburn	Kraft General Foods,				0	
Woburn	Micro-Dynamics, Inc.				0	
Woburn	Photometrics, Inc.				0	
Woburn	Syncor International Corp.				0	
Woburn	Thermedics, Inc.				0	
Woburn	Toxikon Corp.				0	
Subtotal:		26,643.98	0.00	0.00	26,644	227.201
NORFOLK:						
Avon	T.L. Edwards, Inc.				0	
Braintree	American Engineering & Testing, Inc.				0	
Braintree	Clean Harbors Analytical Services, Inc.				0	
Braintree	Wollaston Alloys, Inc.				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
NORFOLK:						
Brookline	Boston Fertility Laboratories, Inc.				0	
Brookline	The Boston Imaging Group, P.C.				0	
Brookline	Dow, Elias Charles (M.D.)				0	
Brookline	Life Signs/Boston, Inc., Boston Cardiovascular Health Center				0	
Canton	CWB Associates, Inc.				0	
Canton	Plymouth Rubber Co., Inc.				0	
Canton	Tamfelt, Inc.				0	
Dedham	American Red Cross Blood Services				0	
Franklin	Digital Equipment Corp.				0	
Franklin	Thermo Environmental Instruments, Inc.				0	
Medfield	CIBA Corning Diagnostics Corp.	23.02			23	.00346
Medfield	Strichman Medical Equipment, Inc.				0	
Millis	GAF Building Materials Corp.				0	
Milton	Milton Hospital				0	
Needham	Abbott BioTech, Inc.	94.6			95	.0285
Needham	Civiltest Laboratories Inc.				0	
Needham	Glover Memorial Hospital				0	
Needham	GTE Government Systems Corp.				0	
Norfolk	Southwood Community Hospital				0	
Norwood	Factory Mutual Research Corp.				0	
Norwood	Norwood Hospital				0	
Plainville	Proscan, Inc.				0	
Quincy	Eastern Nazarene College				0	
Quincy	Herbert V. Shuster, Inc.				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
NORFOLK, continued:						
Quincy	Procter & Gamble Manufacturing Co.				0	
Quincy	Quincy City Hospital				0	
Randolph	Serono Laboratories, Inc.	132.33			132	.033636
Stoughton	Biomedical Technology, Inc.				0	
Stoughton	Goddard Memorial Hospital				0	
Walpole	CIBA Corning Diagnostics Corp.	1126.6			1,127	1.903905
Wellesley	EG&G, Inc.	4.01			4	.030
Wellesley	MA Department of Public Works				0	
Wellesley	Wellesley College				0	
Westwood	Damon Clinical Lab				0	
Westwood	PB Diagnostic Systems, Inc.	45			45	.2582
Weymouth	Gale Associates, Inc.				0	
Weymouth	South Shore Hospital				0	
Wrentham	Bella Construction Corp.				0	
Subtotal:		**1,425.56**	**0.00**	**0.00**	**1,426**	**2.258**
PLYMOUTH:						
Bridgewater	ABC Testing, Inc.				0	
Bridgewater	Bridgewater State College				0	
Brockton	Brockton Hospital				0	
Brockton	Cardinal Cushing General Hospital				0	
Duxbury	Battelle Ocean Sciences				0	
Hingham	Electro Signal Lab, Inc.				0	
Marion	Endeco, Inc.				0	
Middleboro	Ocean Spray Cranberries, Inc.				0	
Plymouth	Bartlett Nuclear, Inc.				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
PLYMOUTH, continued:						
Plymouth	Boston Edison Co.	5969.6	1149.3		7,119	282.665
Plymouth	Jordan Hospital				0	
Rochester	SEMASS Partnership				0	
Rockland	Baker Testing Services, Inc.				0	
Rockland	Briggs Associates, Inc.				0	
Rockland	Nuclear Instrument Co.				0	
Rockland	Vitek Systems	465			465	.952
Wareham	Springborn Laboratories, Inc.	171			171	.005
Wareham	Tobey Hospital, Inc.				0	
Subtotal:		6,605.60	1,149.30	0.00	7,755	283.622
SUFFOLK:						
Boston	Beth Israel Hospital	37			37	.0262
Boston	Boston Biomedical Research Institute				0	
Boston	Boston City Hospital	260			260	.075
Boston	Boston University	85.1			85	.01167082
Boston	Boston University Medical Center	680.5			681	.347158
Boston	Brigham and Women's Hospital	125.2			125	.047457
Boston	Bunker Hill Community College				0	
Boston	Carney Hospital				0	
Boston	Cassidy, Carl E. (M.D.)				0	
Boston	Children's Hospital	7.3			7	.270366
Boston	Dana-Farber Cancer Institute	51.4			51	.143302
Boston	Boston V.A. Medical Center	52.5			53	.0081322
Boston	E.I. DuPont De Nemours and Co.	8547	97.5		8,645	56623.502

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in (curies)
SUFFOLK, continued:						
Boston	Enprotech Corp.				0	
Boston	Eye Research Institute of Retina Foundation				0	
Boston	Forsyth Dental Center				0	
Boston	Faulkner Hospital				0	
Boston	The Gillette Co.				0	
Boston	Institute of Molecular Biology, Inc.	37.5			38	.061
Boston	Joslin Diabetes Center	15.6			16	.903
Boston	Kupferman and Weber, Inc.				0	
Boston	MA Bay Transportation Authority				0	
Boston	MA College of Pharmacy/AHS				0	
Boston	MA Department of Public Health				0	
Boston	Massachusetts Eye & Ear Infimary	7.3			7	.000543
Boston	Massachusetts General Hospital	80.8			81	.1230315
Boston	Massachusetts Port Authority				0	
Boston	MSPCA Angell Memorial Animal Hospital				0	
Boston	Museum of Fine Arts				0	
Boston	New England Aquarium	4.01			4	.00066
Boston	New England Baptist Hospital				0	
Boston	New England Deaconess Hospital	1.375	3.60		5	2.6410328
Boston	New England Medical Center	435			435	.3763
Boston	Nissin Molecular Biology Institute, Inc.	8			8	.001
Boston	Northeastern University	104.25			104	.01640127
Boston	P.X. Engineering Company, Inc.				0	
Boston	Simmons College				0	
Boston	Spaulding Rehabilitation Hospital				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

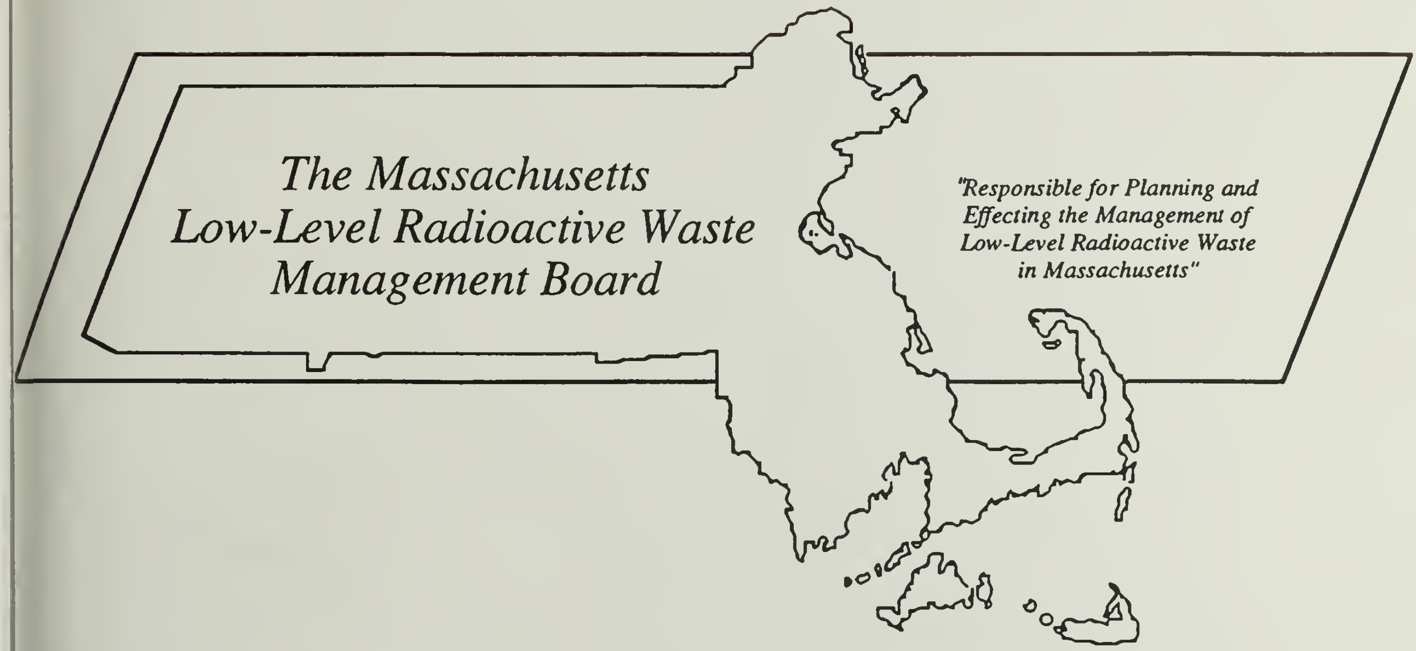
		Volume (in cubic feet)				Activity (in
County/Town	Organization	Class A	Class B	Class C	Total	(curies)
SUFFOLK, continued:						
Boston	Sprogis, David C.				0	
Boston	St. Elizabeth's Hospital				0	
Boston	St. Margaret's Hospital for Women				0	
Boston	Stone & Webster Engineering Corp.				0	
Boston	Suffolk University				0	
Boston	Tufts University School of Medicine	502.5			503	1.2419
Boston	University of Massachusetts at Boston				0	
Boston	USDA Nutrition Research Center	75			75	.05703
Boston	Brockton/West Roxbury V.A. Medical Center				0	
Subtotal:		11,117.34	101.10	0	11,218	56,629.853
WORCESTER:					0	
Barre	Northeast Consultants, Inc.				0	
Clinton	LFE Corp.				0	
Fitchburg	Burbank Hospital				0	
Fitchburg	Fitchburg State College				0	
Fitchburg	McCauley, Robert L. (M.D.) Burbank Hospital				0	
Gardner	Henry Heywood Memorial Hospital				0	
Grafton	Wyman-Gordan Co.				0	
Leominster	Leominster Hospital				0	
Milford	The Center for Diagnostic Products, Inc.				0	
Milford	Milford-Whitinsville Regional Hospital				0	
Milford	Millipore Corp. Waters Chromatography Division				0	
Paxton	Anna Maria College				0	

TABLE 22, continued

Radioactive Materials Users Filing 1990 Survey

County/Town	Organization	Volume (in cubic feet) Class A	Class B	Class C	Total	Activity (in curies)
WORCESTER, continued:						
Shrewsbury	Biohybrid Technologies				0	
Shrewsbury	Digital Equipment Corp.				0	
Southbridge	Harrington Memorial Hospital				0	
Southbridge	Lycott Environmental Research, Inc.				0	
Westborough	Alpha Analytical Laboratories				0	
Westborough	Haller Testing Laboratories, Inc.				0	
West Boylston	Massachusetts Materials Research, Inc.				0	
Worcester	Broggi, Richard J. (M.D.)				0	
Worcester	Cambridge Biotech Corp.	37.5			38	.1066994
Worcester	Clark University				0	
Worcester	College of the Holy Cross				0	
Worcester	The Medical Center of Central Massachusetts				0	
Worcester	The Medical Center of Central Massachusetts Hahnemann Hospital Division				0	
Worcester	Salitsky Alloys, Inc.				0	
Worcester	St. Vincent Hospital				0	
Worcester	TSI Mason Research Institute				0	
Worcester	Universal Metal Corp.				0	
Worcester	University of Massachusetts Medical Center	15			15	.031
Worcester	Wire & Metal Separation Systems, Inc.				0	
Worcester	Worcester City Hospital				0	
Worcester	Worcester Dept. of Public Health				0	
Worcester	Worcester Foundation for Experimental Biology	7.5			8	.006
Worcester	Worcester Polytechnic Institute				0	
Subtotal:		60.00	0.00	0	60	0.144

MASS. LRW1.2:M38/991



The Massachusetts
Low-Level Radioactive Waste
Management Board

*"Responsible for Planning and
Effecting the Management of
Low-Level Radioactive Waste
in Massachusetts"*

1991 Massachusetts Low-Level Radioactive Waste Survey Report

November 1992

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November 1992

Massachusetts Low-Level Radioactive Waste Management Board

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1. Introduction

This report presents low-level radioactive waste (LLW) characteristics compiled from the "1991 Low-Level Radioactive Waste Classification Survey" of licensed radioactive material users. The purpose of the annual LLW survey is to determine the characteristics of LLW produced, treated, stored, or disposed of by users of radioactive materials that are licensed by the U.S. Nuclear Regulatory Commission (NRC). Survey results assist the Management Board in establishing policy on LLW storage, treatment, disposal, and other management methods. Additional copies of this report and further information about its contents can be obtained from the Management Board office, 100 Cambridge Street, Room 903, Boston, MA. 02202 (Telephone (617) 727-6018).

The survey fulfills the requirements of M.G.L. c.111H (Chapter 111H), the Massachusetts Low-Level Radioactive Waste Management Act. Section 7 of Chapter 111H requires that each person who generates, treats, stores, transports or disposes of LLW within the Commonwealth shall annually provide detailed and accurate information concerning the type, volume, radioactivity, source, and characteristics of the LLW as well as current and projected LLW management activities, including source minimization, volume minimization, on-site storage, treatment, packaging and transportation practices.

The annual survey enables Massachusetts to collect data for evaluation in the Management Board's "total hazard" classification system -- a process which categorizes all LLW generated, treated, stored or disposed of not merely on the basis of its radiological characteristics (such as radioactive half-life, principal radionuclides[1] and their concentrations present in the waste, radioisotopic quantities, etc.), but also on its chemical and biological toxicity, chemical reactivity, form, and volume. This classification system is used by the Board to determine which classes of LLW may be stored for decay,[2] which classes will require disposal, and which classes will require special management procedures in order to facilitate the safe and timely closure, post-closure observation and maintenance, and institutional control[3] of any facility accepting LLW in the Commonwealth.

The Management Board has not yet determined whether an in-state storage, treatment or disposal facility should be sited, licensed, built, and operated in Massachusetts. That decision will be made in the spring of 1993, following statewide public hearings. If the decision is made to site a facility, the data acquired from the annual survey will assist the Board and the site community in making informed management decisions that provide for safe, environmentally-sound, facility operation.

LLW Generators

More than 450 hospitals, government agencies, biotechnology firms, and other businesses, including two utilities that operate nuclear power plants, are licensed by the NRC or are registered with the Massachusetts Department of Labor and Industries to use radioactive materials in Massachusetts.[4]

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[1] A "radionuclide" or "nuclide" is an atom that produces radiation, and has a defined half-life. All radionuclides in Massachusetts LLW are listed in Appendix C of this survey report. Their half-lives are segregated according to the length of the decay periods in Tables 17 through 21.

[2] "Storage for decay" is a common treatment procedure, and is defined in Section 2 of this report.

[3] The "closure," "post-closure observation and maintenance" and "institutional control" phases of a facility involve the time, after waste is no longer accepted at the facility (closure), when the facility operator actively monitors and maintains the facility in preparation for the transfer of the facility license from the operator to the Commonwealth (post-closure observation and maintenance), and when the Commonwealth assumes responsibility for continued facility observation, monitoring and care (institutional control). In the case of a disposal facility, these phases could total several hundred years.

Much of the information in this report is grouped by "category" of generator, of which there are five:

(1) Academic (Acad) - universities, colleges and other research institutions;

(2) Commercial (Comm) - organizations such as biotechnology, engineering, and construction companies; testing laboratories; radiopharmaceutical manufacturers and suppliers; defense contractors; and companies using radioactive materials for process and quality control and analysis;

(3) Government (Govt) - local, state, and federal entities, such as water districts, transportation authorities, and health departments;

(4) Health - hospitals, clinics, and physicians; and

(5) Utility - electricity generating power companies that operate nuclear power plants.

LLW is produced as a by-product of various uses of radioactive materials by organizations within these five generator categories. Typical applications of radioactive materials include:

(1) medical procedures such as cancer and thyroid dysfunction diagnosis and treatment, radioimmunoassay, and diagnostic imaging examinations;

(2) research and development in the biotechnology industry for the treatment and prevention of various diseases and medical dysfunctions;

(3) commercial uses such as within instruments that measure level, thickness, and density or that are used in moisture analysis and quality control; sealed sources that are used for industrial radiography of pressure vessels and other structural welds; smoke detectors and exit signs in buildings;

(4) university education and research in medicine, materials science, and biotechnology; and

(5) the production of electricity by nuclear power plants.

LLW takes a variety of forms. It includes radioactively-contaminated dry, solid wastes such as wood, clothing and metal; concentrates from evaporation processes; hardware that has been irradiated as a result of proximity to certain nuclear radiation sources; filters and filter media used in purifying various process streams; ion exchange resins used in water purification and chemical extraction processes; contaminated aqueous and organic liquids used in various analytical procedures and decontamination processes; contaminated used oils from machinery and processes which use radioactive materials; contaminated soil and rubble from the decommissioning and remediation of various facilities; biological waste such as animal carcasses and tissues from biological and medical research and medical diagnosis and treatment; and sludges from various processes.

Types of LLW materials that typically comprise the LLW stream in Massachusetts, the categories of generators producing each type, frequently used treatment processes, and the kinds of containers used for storage and disposal are summarized in Table 1.

---

[4] The total number of radioactive material licensees in Massachusetts varies from time to time due to the expiration or termination of some licenses and the issuance of new ones.

1991 Survey Contents

The 1991 survey of Massachusetts-based radioactive materials users requested information regarding LLW activities for 1991 and 1990, and projections for 1992 through 1994. Data is presented in the subject order of: waste production, waste treatment, waste shipped for disposal to licensed LLW disposal facilities, waste stored on site for future off-site disposal, waste managed through storage for decay, and waste managed by other methods. Tables and figures present values which have been rounded using standard methods, and may not equal 100%. Appendix A lists all organizations responding to the survey and the amount and curies of LLW generated in 1991. Appendix B lists only those LLW generators that shipped waste for disposal, and contains percentage rankings on volume and activity. Appendix C lists all radionuclides contained in Massachusetts LLW.

Table 1
Typical LLW Types, Treatment, and Packaging

Waste Type	Generator Categories Typically Producing Waste	Typical Treatment Used	Container Types Used or Storage and/or Disposal
Dry Active Waste (uncompacted) metal wood concrete hardware	Commercial Academic Health Government Utility	None, decontamination, segregation, sorting, recycle, decay	55 & 30 gallon steel drums, steel boxes
Dry Active Waste (Compactible) paper clothing cloth glassware plastic	Commercial Academic Health Government Utility	Compaction, incineration, segregation, sorting, decay	55 & 30 gallon steel drums, steel boxes, steel cargo vans, plastic boxes
Evaporator Concentrates	Utility	Evaporation, solidification w/cement or polymers	55 gallon steel drums, steel liners
Cartridge Filters for Liquids	Academic Utility	None, dewatering, solidification w/cement or polymers	55 gallon steel drums, steel liners
Granular/Fiber Filter Media for Liquids	Commercial Utility	Dewatering to < 0.5% free water	55 gallon steel drums, steel liners, HIC
Activated Hardware control rods in-core instruments structural materials	Academic Utility	Size reduction	55 gallon steel drums, steel liners, HIC
Contaminated Hardware	Commercial Academic Health Government Utility	None, decontamination, decay	55 & 30 gallon steel drums, steel boxes

Table 1
Typical LLW Types, Treatment, and Packaging
(continued)

Waste Type	Generator Categories Typically Producing Waste	Typical Treatment Used	Container Types Used or Storage and/or Disposal
Ion Exchange Resins (Solidified)	Commercial Utility	Solidification w/cement or polymers	55 gallon steel drums, steel liners, HIC
Ion Exchange Resins (Dewatered)	Commercial Academic Utility	Dewatering to < 0.5% free water	55 gallon steel drums, steel liners, HIC
Contaminated Aqueous Liquids	Commercial Academic Health Government	Incineration, decay, sewarage disposal (see note 5)	55 & 30 gallon steel drums
Contaminated Oils	Commercial Utility	Incineration, solidification, absorption	55 & 30 gallon steel drums, steel liners
Other Contaminated Organic Liquids	Commercial Academic Health Government Utility	Incineration, decay	Incinerated or stored in: 55 & 30 gallon steel drums
Contaminated Rubble, Soil, Sand, etc.	Commercial Academic	None	55 & 30 gallon steel drums, steel boxes, HIC
Other Sludge	Commercial Utility	Dewatering to < 0.5% free water, incineration	55 & 30 gallon steel drums, steel boxes, HIC
Biological Waste carcasses tissue	Commercial Academic Health	Incineration, double containers with absorbents and lime	55 & 30 gallon steel drums, steel boxes, HIC
Depleted Uranium Sludges and Metals	Commercial	Recycling, solidification	55 gallon steel drums, steel boxes

Notes:

(1) HIC means "high integrity container," designed to withstand the effects of disposal for a minimum of 300 years.

(2) Not all waste streams, processes, or containers appear in a given year or from a specified generator category each year.

(3) "Steel Liners" are typically large cylindrical vessels ranging in capacity from 50 to 215 cubic feet.

(4) Other containers used less frequently include small steel pails or cans in the 1/2 to 5 gallon size, and 9 to 10 cubic feet fiber drums used as temporary containment vessels prior to such processing as incineration, where the fiber drum is incinerated also.

(5) NRC regulations permit minute quantities and concentrations of certain radionuclides to be discharged into sanitary sewer systems and into the atmosphere.

2. Waste Management Methods

After LLW is produced, the generator currently has several waste management options available, depending upon the radionuclides involved. The waste can be: shipped to a licensed LLW disposal facility, held in storage for decay, placed in storage for future off-site disposal, or managed by other approved methods. Because of the costs of managing LLW, generators have been forced to research numerous alternatives to handle and reduce waste forms and volumes. Terms used frequently in this report, to describe various management options, include:

"Volume shipped for disposal" represents LLW shipped to a licensed LLW disposal facility. Disposal facilities are located in Barnwell, South Carolina; Hanford, Washington; Beatty, Nevada and Clive, Utah. Volume information is also given by "disposal class" which refers to the NRC disposal classification system contained in Title 10, Part 61, of the Code of Federal Regulations [10 CFR 61]. Four classes of waste are defined:

> Class A wastes are characterized by their low concentrations of long-lived radionuclides and concentrations of short-lived radionuclides that will decay to acceptable levels within a 100-year institutional control period when a disposal facility is maintained after closure. These concentration limits, specified in 10 CFR 61, have been calculated on the basis of acceptable dose limits to an individual who might inadvertently intrude and occupy the disposal site, and encounter waste after this time.
>
> Class B wastes are the next level of wastes which could represent a potential hazard to an inadvertent intruder without additional protective measures, since they contain higher levels of short-lived and long-lived radionuclides. They must meet the NRC's minimum stability requirements so that the waste forms or containers can "maintain gross physical properties and identity, over 300 years" [Part 61.7(b)(3)], thus limiting the exposure to a potential intruder.
>
> Class C wastes are wastes that, due to their greater concentrations of long-lived or short-lived radionuclides, must meet more stringent waste form requirements to ensure stability, and must be disposed of in such a way to protect the inadvertent intruder for a longer period of time. These wastes must meet the stability requirements for form or container (300 years) and must be disposed of in a manner which protects against inadvertent intrusion for at least 500 years. [Part 61.52 (a)(2)]
>
> Greater than Class C (GTCC) wastes are wastes whose concentrations of radioactive isotopes generally make them unacceptable for the types of disposal used for Classes A, B, and C. GTCC wastes continue to be the responsibility of the federal government, not the states. Because no disposal facility exists for GTCC wastes, they must be stored on site.

"LLW volume placed in storage for future off-site disposal" refers to LLW that is being held on site pending future off-site disposal. The volume reported as stored may not reflect the final disposal volume, since the waste may be treated prior to disposal. Waste is commonly held on site for two reasons: to consolidate waste for efficient shipment, or, if the waste is "mixed waste."

"Mixed waste" is contaminated with both hazardous and radioactive material. In Massachusetts, mixed waste is classified using the same NRC disposal classifications listed above with the addition of an "H," for "hazardous", after the classification letter (i.e., Class AH, Class BH, etc.).

With the exception of some mixed waste which can be treated by incineration and other treatment processes, there is a lack of treatment and disposal capacity for the majority of mixed waste in the United States. This is due to the fact that mixed waste is regulated by both the NRC and the U.S. Environmental

Protection Agency (EPA). Treatment and disposal facilities must therefore be licensed and permitted by both of these federal agencies (or complementary state regulatory agencies). Only a handful of companies nationwide have received "Part B" permits from EPA to treat mixed waste prior to disposal, as required by the EPA. Only one disposal site is permitted to accept limited quantities of very low activity mixed waste. That site is the privately-operated Envirocare site in Utah. This situation has forced mixed waste generators to store much of this waste on site.

Treatment is extensively utilized for one type of mixed waste, called liquid scintillation fluid (LSF), if it contains carbon-14 or hydrogen-3 with activity of 0.05 microcuries or less per gram.[5] EPA regulations allow this type of LSF to be incinerated as fuel, and much of the LSF produced in Massachusetts is incinerated in Florida and Tennessee.

"Storage for decay" refers to a procedure in which LLW, with a relatively short half-life, is held for natural radioactive decay in compliance with applicable federal and state regulations. At the end of the storage for decay period, the waste effectively is no longer radioactive, and can be disposed of as normal trash.

"Other management methods" refer to:

(1) small quantities of radioactive materials legally discharged to sewers or released into the atmosphere in accordance with standards set in NRC regulations [10 CFR 20];

(2) on-site incineration;

(3) return to the manufacturer/supplier; and

(4) recycle/recover, which refers to the reuse of materials, typically tools or hardware, after decontamination.

Waste discharged into sanitary sewers, as allowed by 10 CFR 20, must be a readily soluble liquid or a dispersable biological material in water [10 CFR 20.2003 Paragraph (a)(1)]. Strict concentration limits must also be observed so that proper dilution takes place. Atmospheric releases are approved by the NRC on a case by case basis.

Incineration is a treatment technique that reduces the volume of waste. Ash remaining after incineration, if radioactive, is treated as LLW and is shipped to a licensed disposal facility. Some Massachusetts hospitals and universities incinerate the "exempt quantity" types of waste on site; most LLW generators, however, ship their waste off-site and out-of-state for this treatment.

Organizations that return waste to the supplier are typically users of what are known as "sealed sources." A sealed source is radioactive material that is encapsulated in a shell of non-radioactive material. The shell prevents the release of radioactive contamination to the environment. While the shell contains the radioactive material, it also allows radiation -- energy released from the decay of nuclear materials -- to escape so that it can be used for various controlled purposes such as the inspection of pipe welds. After a period of time, the radioactive material in the sealed source eventually will decay, or transform into a non-radioactive element, until the amount of energy being released is so small that the source is no longer useful. Once a sealed source is depleted, it is then returned to the supplier. Other materials or "wastes" returned to the supplier include medical isotope generators, and other medical supplies.

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[5] An NRC regulation in 10 CFR 20 exempts minute quantities of certain radionuclides from requirements for disposal in licensed LLW disposal facilities. This rules applies to LSF as noted, and to animal carcasses containing 0.05 microcuries of carbon-14 or hydrogen-3 per gram of animal tissue. LSF and animal carcasses containing higher levels of these radionuclides cannot be incinerated without regard to their activity. "Activity" or "radioactivity" is the rate of disintegration or decay of radioactive material, and provides a way of quantifying the amount of radioactive material in terms of its radiological nature. A "curie" is a unit of activity, and represents the quantity of any radionuclide that undergoes 37 billion disintegrations per second. A "microcurie" is a millionth of a curie.

Because these various alternative management techniques can reduce or eliminate much of the waste requiring disposal, the volume and activity of LLW shipped to licensed disposal sites is particularly of interest. The following data from the U.S. Department of Energy shows how Massachusetts generators compared to their counterparts in other states with respect to the volume and activity shipped for disposal in 1991:

	Volume (cubic feet)	Activity (curies)		Volume (cubic feet)	Activity (curies)
Pennsylvania	224,561	354,340	Mississippi	9,967	2,703
Illinois	101,949	103,358	Louisiana	9,961	820
New York	99,310	103,358	S. Dakota	9,729	603
Oregon	80,269	49	Maine	9,457	376
California	72,160	7,050	Utah	7,839	62
Virginia	66,527	3,664	Wisconsin	7,228	1,012
Tennessee	60,458	2,071	Indiana	5,724	370
New Jersey	57,525	45,707	Kansas	3,675	1,356
Texas	53,087	4,155	Hawaii	2,958	6
Connecticut	48,814	3,596	Kentucky	2,348	631
Washington	46,715	1,544	Colorado	2,221	8,095
S. Carolina	45,540	1,399	Nevada	1,815	5
Minnesota	43,521	4,031	D. Columbia	1,206	3
Massachusetts	42,686	32,531	Delaware	775	1
Georgia	35,410	6,828	New Mexico	746	2
N. Carolina	33,497	6,789	W. Virginia	368	15
Ohio	24,336	3,840	Rhode Island	361	<1
Maryland	19,228	9,347	Army out U.S.	354	82
Florida	19,137	1,140	N. Hampshire	235	<1
Arizona	18,698	908	Alaska	70	743
Oklahoma	17,608	18	Montana	53	2
Vermont	17,138	119,642	Idaho	30	42
Alabama	15,010	37,507	N. Dakota	11	55
Arkansas	14,830	831	Wyoming	1	3
Iowa	12,815	529	Puerto Rico	0	0
Nebraska	10,700	657	Michigan	0	0

3. Survey Form Description

The 1991 survey form consists of 13 parts and is arranged in tabular or spreadsheet fashion with rows and columns. The parts of the form are arranged side by side, in ascending order, with 15 rows to each part. Fourteen rows are provided for waste category information, one category per row; the last row is for column totals. Each part relates to a different aspect of LLW management.

Part I: General Information. This part requests the company or institution's license and product information as well as a signature certifying the accuracy of the information. In addition, questions are asked as an initial screen to identify users of radioactive materials that did not produce LLW during the survey year, and those that used radioactive materials in "sealed sources." For those categories of radioactive material users, completion of the rest of the survey is not required.

Part II: Waste Category Identification. This part requests the name of the city and county where waste is generated and a general description of the waste.

Part III: Waste Handled or Processed Off-Site By Others. This part requests the volume and activity of waste that is handled by companies, known as "brokers," which arrange for the collection, transportation, treatment, storage or disposal of the LLW, as well as "processors" who operate LLW treatment facilities.

Part IV: Physical and Chemical Properties. This part requests information about the chemical or hazardous properties of the waste, and information regarding on-site treatment.

Part V: Disposal Data for Wastes Shipped for Off-Site Disposal This Year. This part requests the volume of waste shipped for disposal, and a physical description of the disposal container, the NRC disposal class, and disposal site.

Part VI: Data for Wastes Placed in Storage for Future Off-Site Disposal. This part requests information identical to Part V but for wastes placed in storage in the survey year for future off-site disposal. Other waste reported in this section of the survey may be waste the generator hopes can be recycled and reused, waste being stored for partial decay before it is shipped for disposal, mixed waste, or waste being held for consolidation to provide more efficient shipments.

Part VII: Other Waste Management Methods Used This Year for Radioactive Materials. This part requests volume and activity data on waste that was managed by storage for decay or other NRC-licensed methods such as sewer or atmospheric disposal. In addition, data for wastes recycled or returned to the manufacturer are to be reported here.

Part VIII: Expected Waste Category Changes. Expected future changes in LLW volume, activity, and radionuclide content of the licensee's LLW stream are requested by this part of the form.

Part IX: Total Waste Accumulated in Storage for Off-Site Disposal. This part requests the volume, activity and predicted treatment of LLW that has accumulated in on-site storage for future disposal.

Part X: Waste Category Termination, Decontamination, and Decommissioning Information. This part requests the volume, activity, description, and predicted disposal class of waste that will be produced as a result of facility decontamination and decommissioning.

Part XI: Radiological Data. This part requests the curie content of the waste, radioisotopic quantities, and radiation levels at the surface of the waste container.

Part XII: Number of Waste Shipments By Type Made in 1991. This part requests data on the type and quantity of shipments made to brokers, processors, or directly to disposal sites.

Part XIII: Waste Quantity Projections. The last part of the survey form requests generator projections of their LLW activities for the upcoming three years.

An integral part of the survey form is the classification code sheet. The sheet contains specific codes to describe characteristics of particular interest. Codes are provided for the following parameters:

(1) the county in which waste is generated;

(2) waste category description;

(3) general and EPA/Massachusetts Department of Environmental Protection (DEP) treatment methods;

(4) broker/processor utilized;

(5) physical matrix;

(6) EPA/DEP hazard code;

(7) chelating agents;[6]

(8) disposal site utilized;

(9) NRC disposal classification;

(10) storage site utilized;

(11) alternate waste management methods; and

(12) NRC/U.S. Department of Transportation (DOT) waste transportation class.

The code system precludes the need to predetermine an alpha numeric code for each type of waste. Instead, waste can be described by a combination of codes, thus allowing each individual waste stream to be assigned a unique code and classified, as necessary, for management purposes.

Once the survey form is completed by the generator, and returned to the Management Board, the information is entered directly from the form into a database program. The database program serves as an analytical tool to compile data by any characteristic code of interest, and to enable the Board to annually update its forecasts of waste volumes for various decision-making purposes.

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[6] "Chelating agents" means certain organic compounds capable of forming (multiple) coordinate bonds with metals through two or more atoms of the organic compound, typically resulting in enhanced thermodynamic stability in solution and greatly altered behavior of the metal ions. Examples include amine polycarboxylic acids (e.g., EDTA, DTPA), and polycarboxylic acids (e.g., citric acid, carbolic acid, and gluconic acid). Chelating agents are used to reduce or eliminate metals from radioactively-contaminated solutions.

4. Summary of 1991 Survey Data

The 1991 LLW Classification Survey was mailed to all licensed and/or registered users[7] of radioactive materials in the Commonwealth, of which there were 461 at the time of the survey's distribution. The survey response was 95%.

Of the 461 licensees surveyed, 232 (or 50%) indicated that their use of radioactive materials resulted in the production of LLW; the remainder used sealed sources or did not possess radioactive material in 1991, and therefore, did not produce any LLW.

Of the 232 organizations which produced LLW, 103 indicated that they shipped all, or part, of their waste for disposal to one of the four licensed disposal facilities. The remainder managed their waste in a manner other then licensed land disposal, such as storage for decay. Some generators managed their waste by both shipping to a licensed disposal facility or another management method.

Economic Summary

An important addendum to the 1991 survey requested cost/benefit information from the users of radioactive material in the Commonwealth. Survey responses indicated that 16,715 people are directly, and 19,415 are indirectly, involved in the use of radioactive material. Survey respondents reported total revenues of approximately 2.97 billion dollars, or 2% of the Gross State Product for 1989, the last year such information was available.[8] Table 2 summarizes the economic information.

Table 2
Employment Level and Revenues Reported by Radioactive Materials Users
By Generator Category

Generator Category	Direct Employees[1]	Indirect Employees[1]	Revenues
Academic	6,356	4,034	$539,073,298
Commercial	4,[illegible]34	5,976	$1,749,195,959
Government	7	20	$440,000
Health	4,388	5,553	$349,279,248
Utility	1,660	3,832	$330,000,000
Total	16,715	19,415	$2,967,988,505

[1] "Direct" employees are those who personally work with radioactive materials. "Indirect" employees are those who are employed by companies and institutions that use these materials, but do not work directly with them.

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[7] Licensee lists from the NRC and registrant lists from the Massachusetts Department of Labor and Industries were consulted to determine the number of licensees registrants as of December 1991.

[8] Because the economic information was requested on a different "due date," fewer generators (64%) responded than the 95% response rate for the rest of the annual survey. Were the response rate higher, the data would likely show larger revenues and greater numbers of involved employees.

LLW Production and Disposition Summary

During 1991, Massachusetts generators produced 152,292 cubic feet of LLW, of which:

- 49,727 cubic feet (32.6%) was eliminated by treatment methods;
- 42,686 cubic feet (28.0%) required disposal in a licensed disposal facility;
- 8,316 cubic feet (5.5%) was placed in storage for future off-site disposal;
- 38,219 cubic feet (25.1%) was managed by storage for decay; and
- the remainder, 13,344 cubic feet (8.8%), was managed by other management methods such as incineration, recycling, sewer disposal, etc.

Table 3 and Figure 1 summarize this production and disposition data applicable to 1991.

Table 3
Summary of 1991 LLW Production and Disposition by Various Management Methods
(cubic feet)

Production/Disposition	Generator Category					Total	% Total
	Academic	Commercial	Government	Health	Utility		
Produced	18,845	66,250	726	19,745	46,726	152,292	N/A
Volume Eliminated by Treatment	2,003	17,162	14	2,011	28,537	49,727	32.6
Shipped for Disposal	1,410	21,646	14	1,471	18,145	42,686	28.0
Storage for Future Off-Site Disposal	472	6,927	660	213	44	8,316	5.5
Storage for Decay	7,119	18,010	37	13,053	0	38,219	25.1
Other Management Methods	7,841	2,505	1	2,997	0	13,344	8.8

Figure 1
1991 LLW Production and Disposition by Various Management Methods

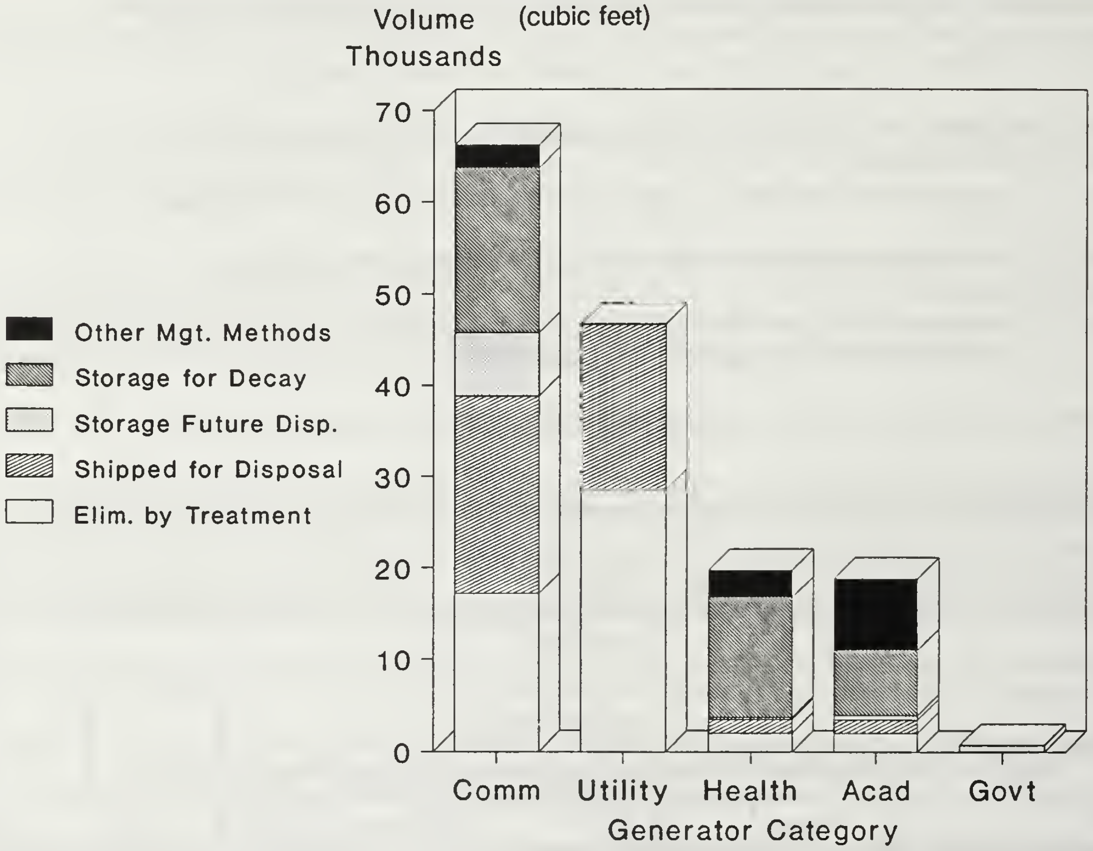


Figure 2 dramatically illustrates that the vast majority of all LLW produced is managed by methods other than shipment to licensed LLW disposal sites.

Figure 2

1991 LLW Volume Produced Versus Shipped for Disposal-By Generator Category

(cubic feet)

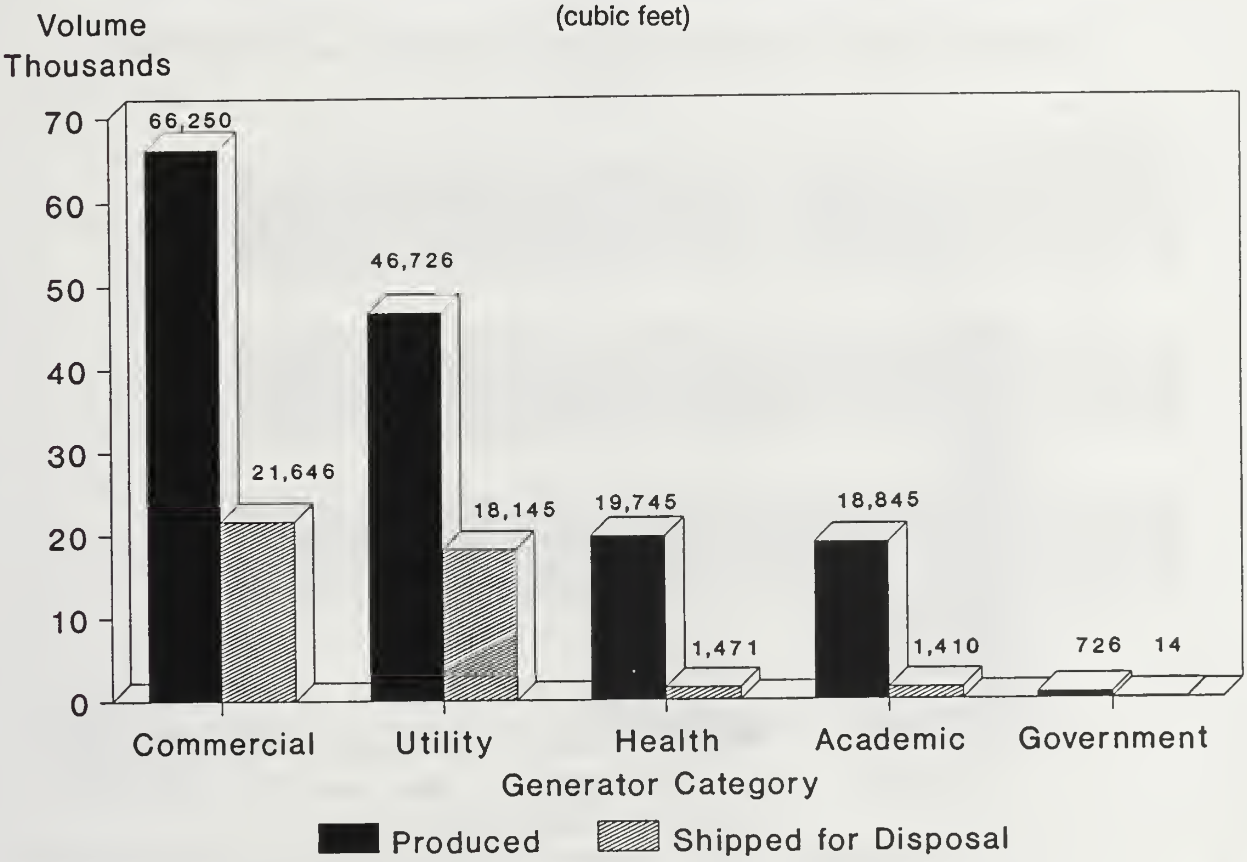


Figure 3 shows the breakdown by NRC classifications of waste managed only by licensed land disposal. It does not include waste managed by other methods, such as storage for decay. Class A "unstable" waste contains the radionuclide contents of Class A waste, but because it does not meet the structural stability requirements of Class A "stable" waste, it must be segregated and disposed of separately from other waste classes.

Figure 3
1991 LLW Produced and Shipped for Disposal-By NRC Disposal Classification
(cubic feet)

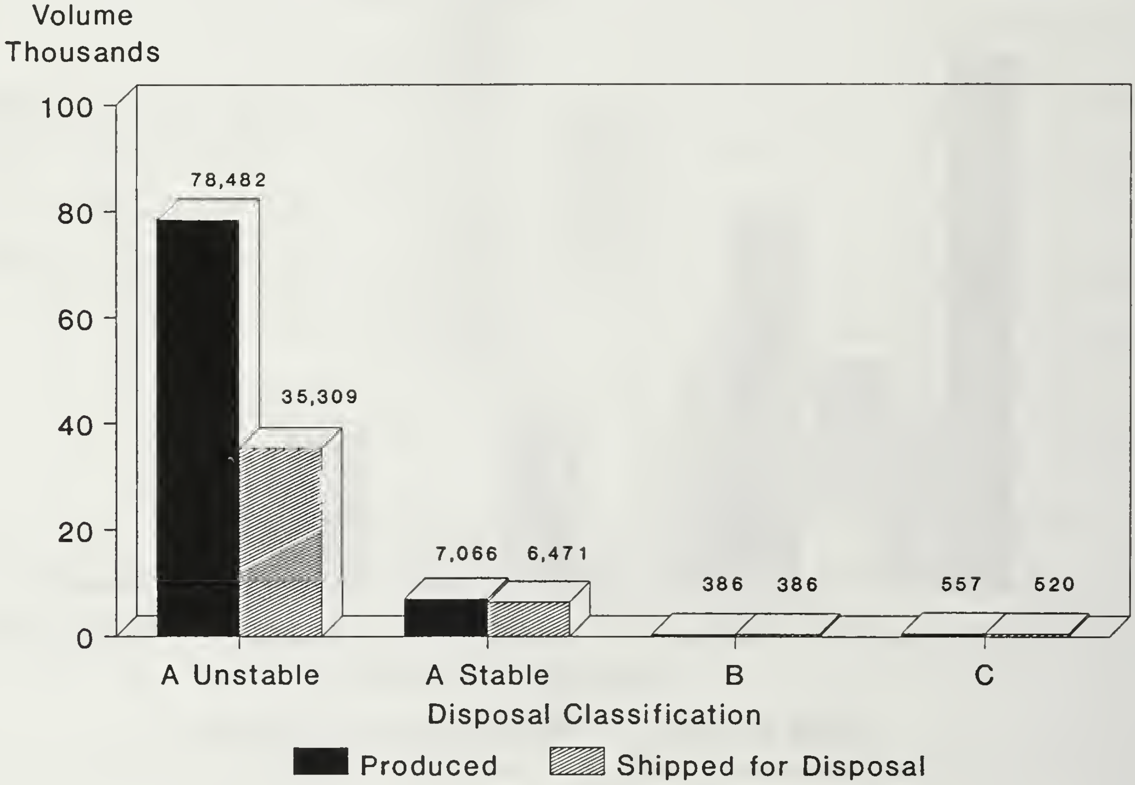
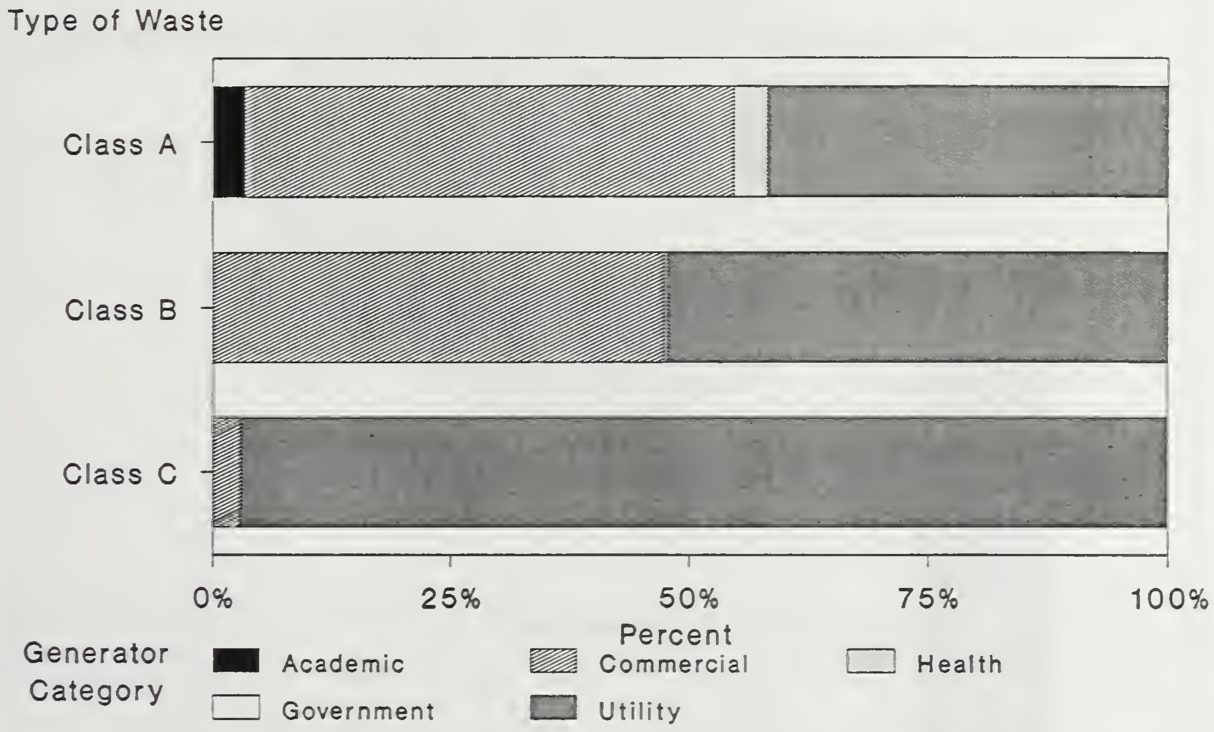


Figure 4 illustrates the percentage by generator category of Classes A, B, and C waste shipped for disposal.

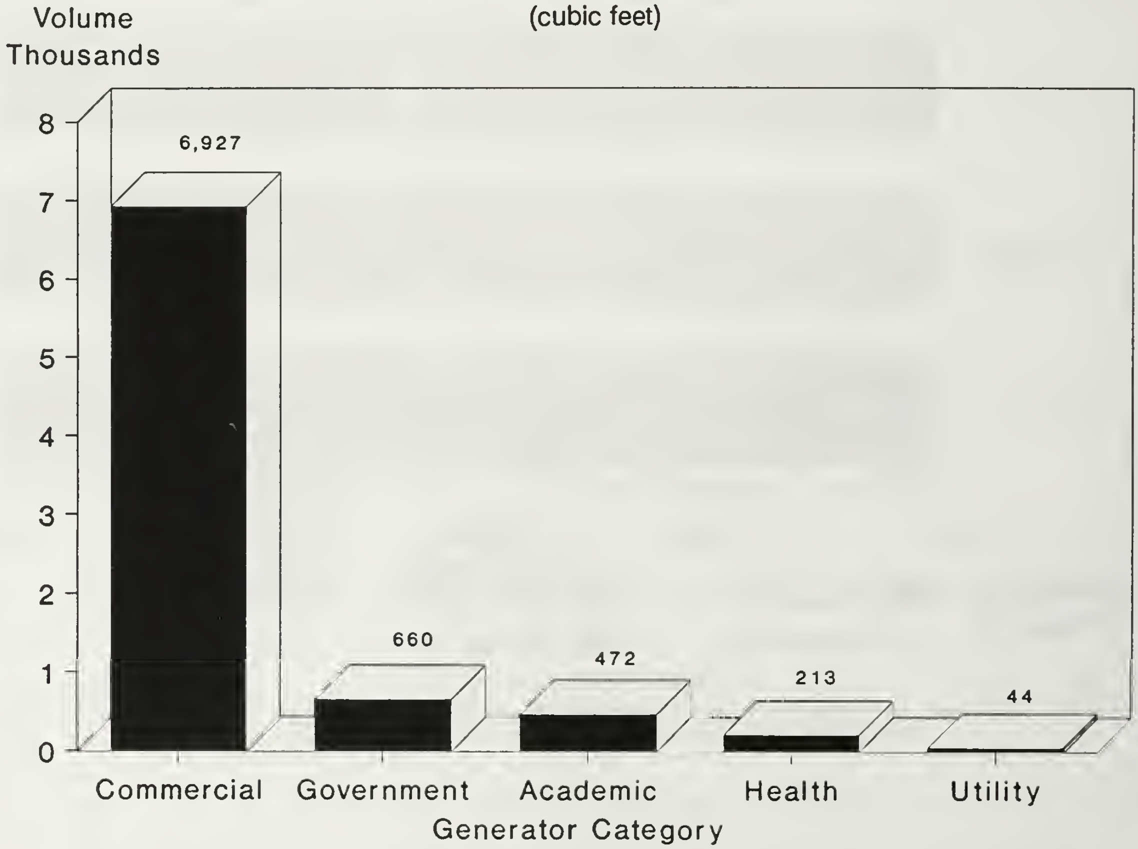
Figure 4
Volume of Waste Classes Shipped for Disposal, by Percentage of Generator Category



Storage for Future Off-Site Disposal

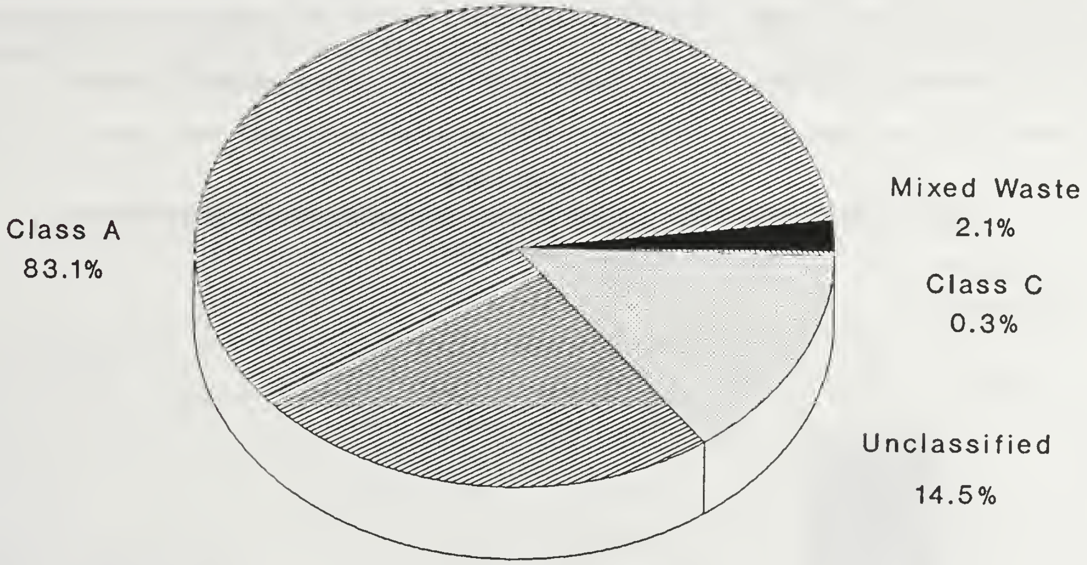
Figure 5 illustrates the portion of the total 1991 LLW volume that was placed in storage for future off-site disposal. During 1991, 8,316 cubic feet of waste was placed in storage for future off-site disposal. Generators place waste in storage for several reasons, including accumulating enough waste for an efficient shipment, allowing the radioactivity to partially decay prior to shipment, or due to a lack of available disposal capability (as is the case for mixed waste).

Figure 5
1991 LLW Placed in Storage for Future Off-Site Disposal By Generator Category
(cubic feet)



The NRC prohibits on-site storage for more than five years, and sets an allowable storage period for each radioactive materials user as part of the licensing process. Most Massachusetts-based NRC licensees have licenses permitting them to store for two or three years, maximum. Of the 8,316 cubic feet placed in storage during 1991, 6,910 cubic feet (83.1%) is Class A waste; 1,205 cubic feet (14.5%) is unclassified (i.e., waste that has not yet been identified as waste according to the NRC disposal classifications); 173 cubic feet (2.1%) is mixed waste; and the remaining 29 cubic feet (0.3%) is Class C waste (Figure 6). No Class B waste was reported having been placed in storage for future off-site disposal during 1991.

Figure 6
1991 LLW Placed in Storage for Future Off-Site Disposal

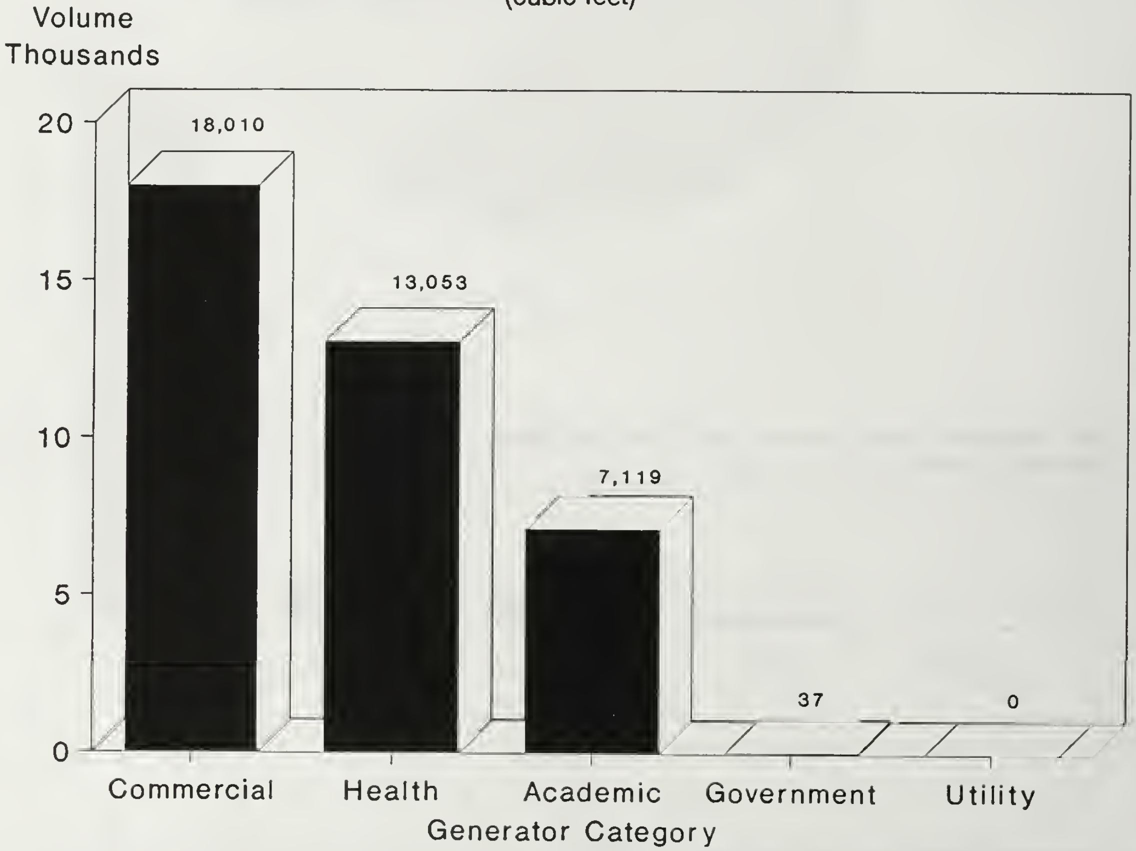


Note: Unclassified waste is waste that has not yet been classified by the generator in accordance with the NRC disposal classification system.

Storage for Decay

Storage for decay is practical for waste that contains radionuclides with relatively short half-lives. A rule of thumb has been that after a decay time of approximately 10 half-lives, the initial activity of industrial and medical radiochemicals will have decayed sufficiently for the waste to be disposed of as essentially non-radioactive trash. This practice, coupled with NRC license limitations[9] on the quantities of materials that may be stored on site, restrict this method of management to wastes that contain radionuclides with half-lives of less than about 90 days, assuming a three-year storage limit. Because many of the radioactive isotopes used by commercial and medical LLW generators have half-lives less than 90 days, storage for decay is a common practice in Massachusetts and elsewhere, as is illustrated in Figure 7.

Figure 7
1991 LLW Volume Managed by Storage for Decay-By Generator Category
(cubic feet)



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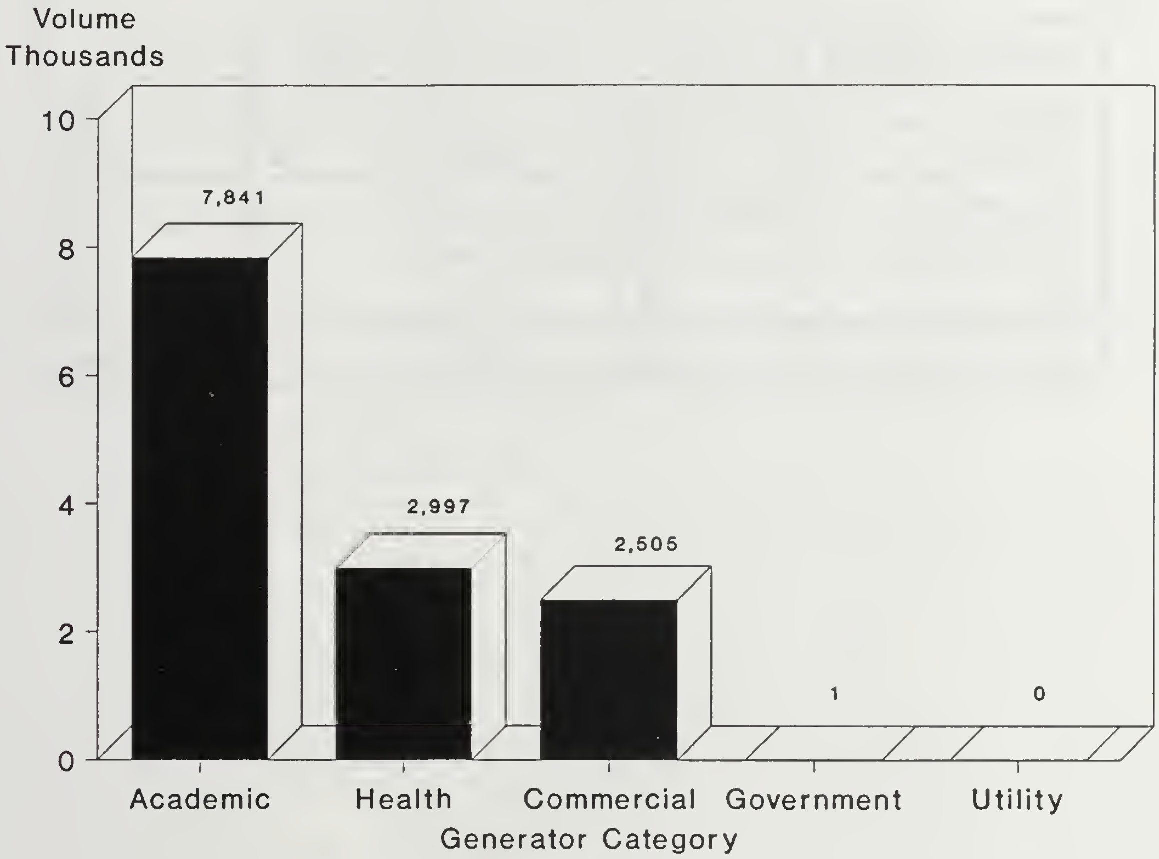
[9] The type of radionuclide and the length of the storage for decay period are specified by the NRC license held by each generator. One license may allow a two-year period of storage for decay; another license may allow a three-year period. The longest storage for decay period currently permitted by the NRC (with the exception of nuclear power plants) is five years. However, most licensees in Massachusetts store for a maximum of three years.

Other Management Methods

Figure 8 shows the portion of the total 1991 LLW volume that was managed by sewer or atmospheric release, on-site incineration, return to the manufacturer\supplier, and recycle\recovery. The figure shows no waste managed through any of these means by the two utility generators, based on the responses received in their surveys. It is routine practice for utilities and other generators to release small quantities of radioactive materials to the atmosphere, in accordance with allowable NRC regulations. In the case of atmospheric emissions, if these radioactive gases were packaged for disposal in a licensed LLW disposal facility, they would be LLW. Because they are released to the atmosphere, not all generators consider them LLW for purposes of the waste volume they generate, and the data they report.

Figure 8
1991 LLW Volume Managed by Other Methods-By Generator Category
(cubic feet)



Radioactivity of LLW Shipped for Disposal

In addition to the volume of LLW generated, another LLW characteristic of interest, is the activity of the waste. Table 4 shows 1991 activity of waste shipped for disposal by disposal class and generator category. That year, 31,032 (95.4%) of the 32,531 curies of radioactivity shipped for disposal to a licensed disposal facility was tritium-contaminated waste. Tritium, an isotope of hydrogen with a half-life of 12.4 years, is used in the manufacture of radiopharmaceutical products and for research. The majority of tritium, approximately 29,000 curies, was shipped by a single generator in the "commercial" category in waste classified as Class B (Figures 9 and 10). Though comprising only 0.9% of the total volume shipped for disposal, Class B waste contained 91.7% of the total activity shipped for disposal in 1991.

Table 4
1991 Activity by Generator Category and Waste Disposal Class
LLW Shipped for Disposal

Generator Category	Class A	Class B	Class C	Total
Academic	36.3	0	0	36.3
Commercial	1595	29,808	223	31,626
Government	0.602	0	0	0.602
Health	70.2	1.02	0	71.2
Utility	170	9.0	618	797
Total	1,872	29,818	841	32,531

Figure 9
1991 Activity Shipped for Disposal-By Percentage of Generator Category

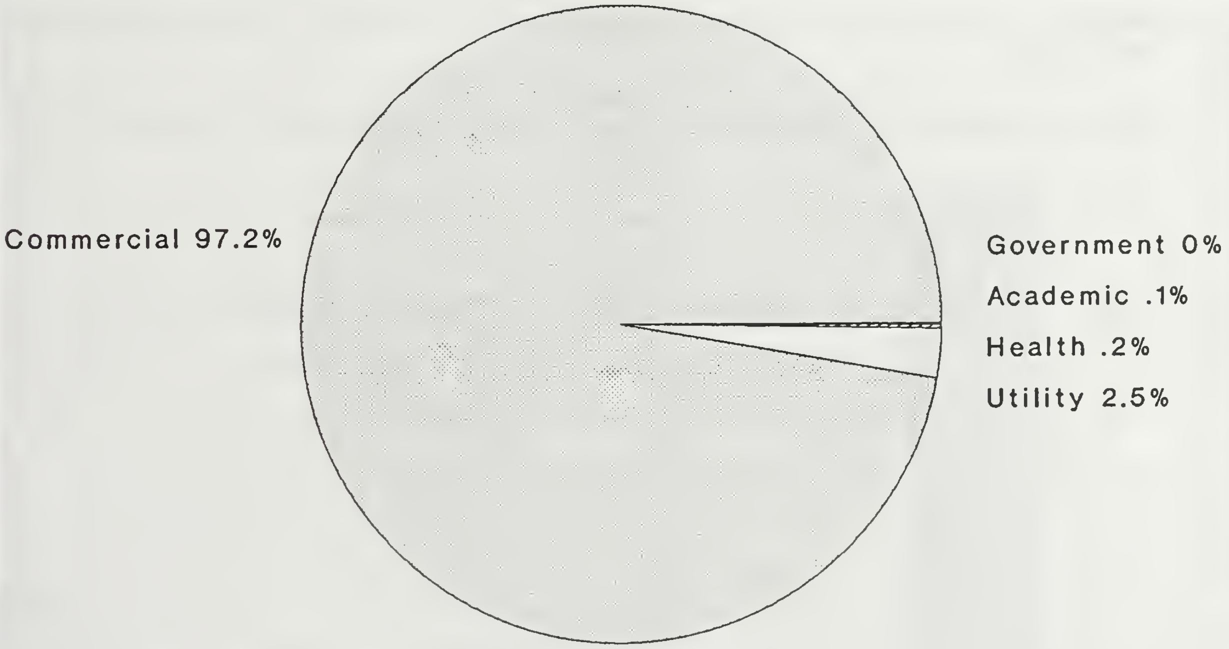
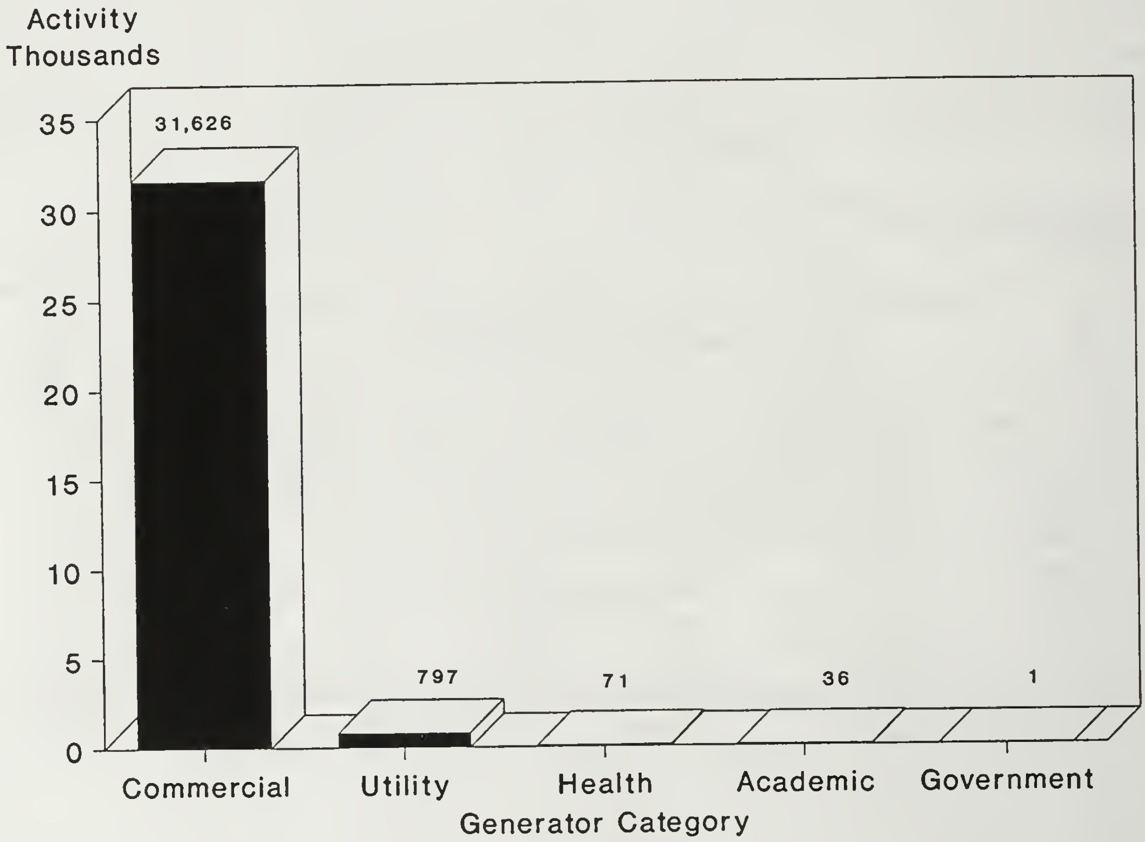


Figure 10
1991 LLW Activity Shipped for Disposal-By Generator Category
(curies)



5. Characteristics of 1991 Massachusetts LLW

The following tables present detailed characteristics of the 1991 Massachusetts LLW stream. Features include data on numerous management activities.

Table 5
1991 LLW Volume Produced Prior to Processing-By Disposal Class and Generator Category
(cubic feet)

Waste Class	Generator Category					Total	% of Total
	Academic	Commercial	Government	Health	Utility		
A Unstable	2,482	33,272	6	2,043	40,680	78,482	51.5
A Stable	80	801	8	882	5,295	7,066	4.6
B	0	183	0	1	202	386	0.3
C	0	53	0	0	505	557	0.[illegible]
GTCC	0	0	0	0	0	0	0.0
Mixed	99	247	0	182	0	528	0.3
Other	16,184	31,695	712	16,637	44	65,272	42.9
Total	18,845	66,250	726	19,745	46,726	152,292	100
% of Total	12.4	43.5	0.5	13.0	30.7	100	

The waste class "other" includes waste placed in storage for future off-site disposal, waste managed by storage for decay, and other management methods summarized in Table 14; and waste that did not require land disposal after treatment by a broker.

Table 6
1991 LLW Volume Produced Prior to Processing-By Waste Type and Generator Category
(cubic feet)

Waste Type	Generator Category					Total	% of Total
	Academic	Commercial	Government	Health	Utility		
Liquids	9,291	17,635	[illegible]	2,395	2,885	32,178	21.7
Wet Solids	0	7	0	0	5,471	5,478	3.6
Solids	9,554	48,607	725	17,342	38,400	114,628	75.3
Gas	0	0	0	8	0	8	0.0
Total	18,845	66,250	726	19,745	46,726	152,292	100
% of Total	12.4	43.5	0.5	13.0	30.7	100	

Table 7
Summary of 1991 LLW Volume Reduced By Generator and Processor Treatment-By Generator Category
(cubic feet)

Generator Category (Total #)	Volume							
	Storage for Decay	Compaction	Inciner-ation	Transfer to Broker/ Processor	Return to Manufacturer /Supplier	Recycle/ Recover	Sewer Release	Atmos-pheric Release
Academic (30)								
No. Using	22	10	9	4	0	0	13	0
% of	73	33	30	13.3	0	0	13	0
Initial	7,119	1,418	397	3,711	0	0	5,556	0
Final	7,119	1,061	0	1,331	0	0	0	0
VR Factor[1]	5	1.3	N/A	N/A	N/A	N/A	N/A	N/A
Commercial (114)								
No. Using	69	31	27	78	[illegible]	1	32	2
% of	61	27	24	68	4	1	28	2
Initial	17,972	8,366	8,725	11,856	149	23	2,036	0.00001
Final Volume	451	2,107	281	5,363	0	0	0	0
VR Factor	40	4	31	2.2	N/A	N/A	N/A	N/A
Health (83)								
No. Using	73	6	8	39	17	0	11	0
% of Health	88	7	10	47	20	0	13	0
Initial Volume	13,053	1,026	1,206	3,523	920	0	330	0
Final Volume	198.8	428	0	1240	0	0	0	0
VR Factor	66	2.4	N/A	2.8	N/A	N/A	N/A	N/A

Table 7
Summary of 1991 LLW Volume Reduced By Generator and Processor Treatment-By Generator Category

(cubic feet)
(continued)

Generator Category (Total #)	Volume							
	Storage for Decay	Compaction	Incineration	Transfer to Broker/ Processor	Return to Manufacturer /Supplier	Recycle/ Recover	Sewer Release	Atmospheric Release
Government (3)								
No. Using	1	0	0	1	0	0	1	0
% of Govt.	33	0	0	33	0	0	33	0
Initial Volume	36.5	0	0	7.5	0	0	0.9	0
Final Volume	15	0	0	7.5	0	0	0	0
VR Factor	[illegible]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Utility (2)								
No. Using	0	0	2	1	0	0	0	0
% of Utility	0	0	100	50	0	0	0	0
Initial Volume	0	0	28,545	250	0	0	0	0
Final Volume	0	0	5,427	123	0	0	0	0
VR Factor	N/A	N/A	5.3	2	N/A	N/A	N/A	N/A
Total								
Initial Volume	38,180	10,810	38,873	19,347	1,069	23	7,923	0.00001
Final Volume	2,074	3,596	5,708	10,347	0	0	0	0
VR Factor	18	3	5.3	1.8	N/A	N/A	N/A	N/A

[1] VR = ratio of initial to final volume

Totals in this table may not compare to other table totals, due to reporting inconsistencies. The sub-section of this report identified as "Other Management Methods" describes assumptions made about atmospheric releases by utility and other generators, and explains why no volume is shown as having been generated, or reduced through atmospheric emissions.

Table 8
1991 LLW Volume and Activity Shipped for Disposal-By Disposal Class and Generator Category
(cubic feet or curies)

Generator Category	Disposal Class			Total Volume		Total Activity	
	Class A	Class B	Class C	Total	% of Total	Curies	% of Total
Academic	1,410	0	0	1,410	3.3	36	0.1
Commercial	21,449	183	15	21,646	50.7	31,626	97.2
Health	1,469	[illegible]	0	1,471	3.4	71	0.[illegible]
Government	14	0	0	14	[illegible]	1	0.0
Utility	17,438	202	505	18,145	42.5	796	[illegible]
Total	41,780	386	520	42,686	100	32,530	100
% of Total	97.9	0.9	1.2	100			

Non-utility generators continue to produce and ship for disposal the largest amount of LLW. In 1991, of the 42,686 cubic feet of volume and 32,530 curies of activity shipped to the four licensed LLW disposal facilities, 57.5% of the volume and 97.5% of the activity were shipped by non-utility generators; 42.5% of the volume and 2.4% of the activity were shipped by the utilities. These figures are the reverse of patterns in most other states, where nuclear power plant LLW production far exceeds LLW generation by the other generator categories.

Of the 232 radioactive materials licensees that generated LLW in 1991, nine produced 85.5% of the total volume, and three produced 98.6% of the total activity of waste shipped for disposal. Each of these generated 1% or more of the total volume or activity shipped. They are shown in Figures 11 and 12. All 1991 licensees are listed in Appendix A, and all 1991 LLW generators are listed in Appendix B.

Figure 11
Generators that Shipped More than One Percent of 1991 Volume

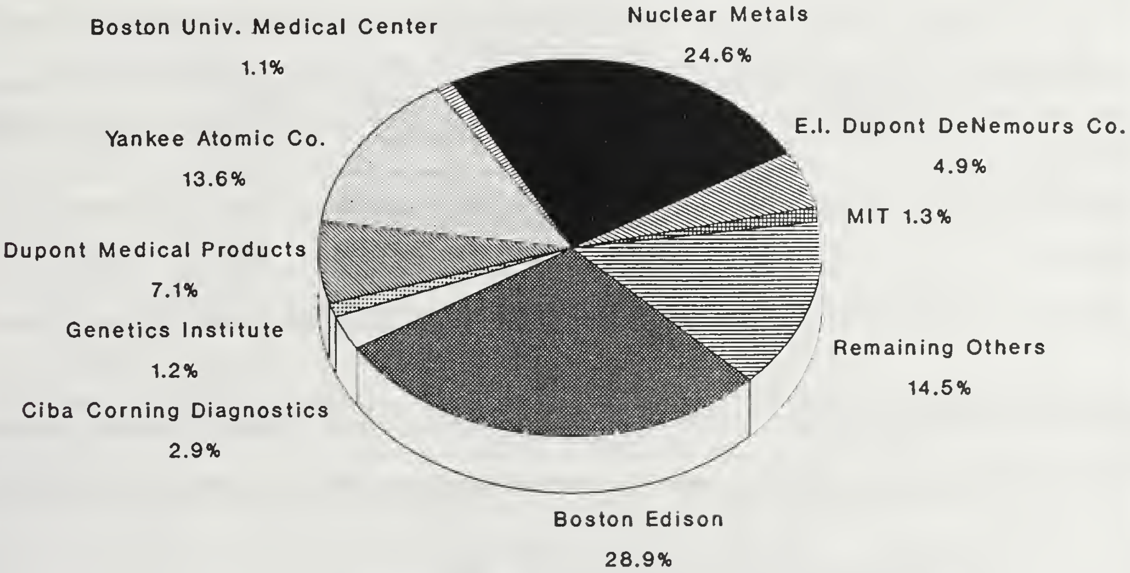


Figure 12
Generators that Shipped More than One Percent of 1991 Activity

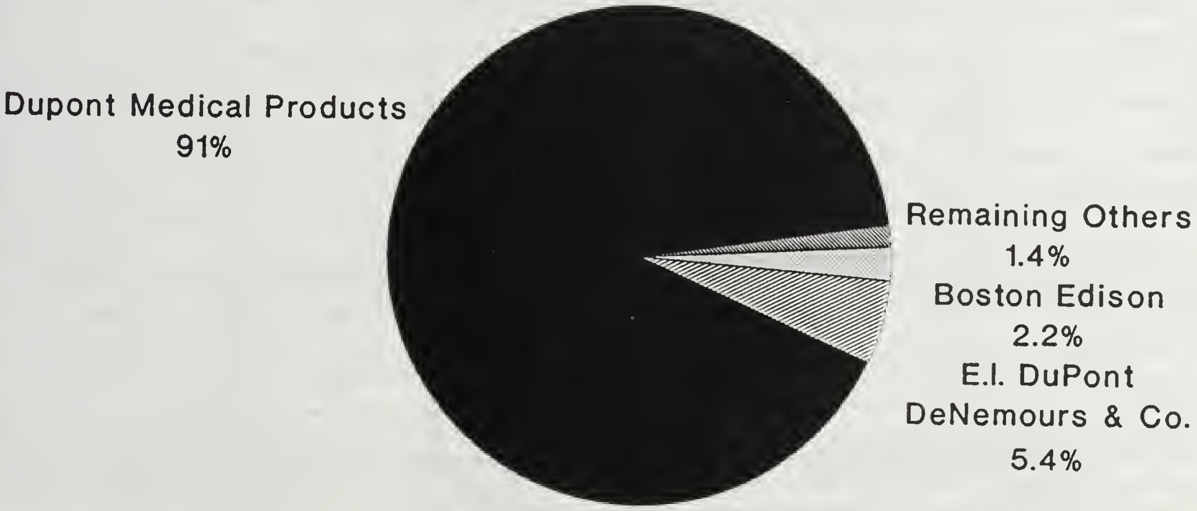


Table 9
1991 LLW Volume Shipped for Disposal-By Waste Type and Generator Category
(cubic feet)

Waste Type	Generator Category					Total	% of Total
	Academic	Commercial	Government	Health	Utility		
Liquids	65	11,348	0	184	2,836	14,432	33.8
Wet Solids	0	0	0	0	5,471	5,471	12.8
Solids	1,346	10,298	14	1,287	9,838	22,783	53.4
Gas	0	0	0	0	0	0	0.0
Total	1,410	21,646	14	1,471	18,145	42,686	100
% of Total	3.3	50.7	0.0	3.4	42.5	100	

Table 10
1991 LLW Volume and Activity Shipped for Disposal-By Disposal Class
(cubic feet & curies)

Disposal Class	Volume	Activity	Volume % Of Total	Activity % Of Total
A Unstable	35,309	1,630	82.7	[illegible].0
A Stable	6,471	242	15.2	0.7
B	386	29,818	0.9	91.7
C	520	841	1.2	2.6
Greater Than Class C	0	0	0.0	0.0
A Unstable Hazardous	0	0	0.0	0.0
A Stable Hazardous	0	0	0.0	0.0
B Hazardous	0	0	0.0	0.0
C Hazardous	0	0	0.0	0.0
Greater than Class C Hazardous	0	0	0.0	0.0
Total	42,686	32,531	100	100

Table 11 represents LLW accumulated in storage, for off-site disposal, during 1991 and previous years, and includes mixed waste. The volume reported here and in Table 12 does not necessarily reflect final disposal quantities, since additional treatment and repackaging may be undertaken prior to disposal.

Table 11
Total LLW Volume Accumulated in Storage for Future Disposal
(cubic feet)

	Generator Category					Total
	Academic	Commercial	Government	Health	Utility	
Volume	718	27,221	682	153	310	29,084

Table 12
1991 LLW Volume Placed in Storage for Future Off-Site Disposal
(cubic feet)

Disposal Classification	Generator Category					Total	% of Total
	Academic	Commercial	Government	Health	Utility		
Unclassified[1]	341	836	0	27	0	1,204	14.5
A Unstable	100	646	0	165	15	926	11.1
A Stable	0	5,320	660	[illegible]	0	5,984	72.0
B	0	0	0	0	0	0	0.0
C	0	0	0	0	29	29	[illegible]
Greater than Class C	0	0	0	0	0	0	0.0
A Unstable Hazardous	31	112	0	0	0	143	1.7
A Stable Hazardous	0	13	0	17	0	30	0.4
B Hazardous	0	0	0	0	0	0	0.0
C Hazardous	0	0	0	0	0	0	0.0
Greater than Class C Hazardous	0	0	0	0	0	0	0.0
Total	472	6,927	660	213	44	8,316	100
% of Total	5.7	83.3	7.9	2.6	0.5	100	

[1] Unclassified waste is waste which has not yet been classified using the NRC disposal classification system. This waste may contain minimal quantities of certain radionuclides which may be managed by methods such as incineration.

Table 13
1991 Liquid Scintillation Fluid Volume Incinerated-By Generator Category
(cubic feet)

Liquid Scintillation Fluid Types	Generator Category					Total
	Academic	Commercial	Government	Health	Utility	
Organic	230	915	0	862	0	2007
Inorganic	1,324	238	0	198	0	1760
Total	1,554	1,153	0	1,060	0	3,767

Table 13 represents liquid scintillation fluid (LSF) that was shipped to off-site incineration facilities. Survey data indicates that 10,390 cubic feet of LSF was produced in 1991, of which only 3,802 cubic feet contained "hazardous" mixed waste materials. Of the 3,802 cubic feet of LSF that was designated as mixed waste, 3,767 cubic feet were reported as having been incinerated, 30 cubic feet were treated and shipped for disposal, and 4.5 cubic feet were placed in storage for future disposal. The remaining 6,588 cubic feet of LSF was either comprised of non-hazardous compounds (which may be substituted for hazardous materials), or was incorrectly reported by some small generators who were not as familiar with mixed waste, and may therefore have underreported their LSF category. The 1992 survey will attempt to clarify this issue.

Table 14
1991 LLW Volume Managed by Other Methods-By Generator Category
(cubic feet)

Management Method	Generator Category					Total
	Academic	Commercial	Government	Health	Utility	
Store For Decay	7,119	18,010	37	13,053	0	38,219
Incineration*	2,285	297	0	1,747	0	4,329
Return To Manufacturer\Vendor	0	150	0	920	0	1,070
Recycle\Recover	0	23	0	0	0	23
Sewer Discharge	5,556	2,036	0	330	0	7,922
Total	14,959	20,515	37	16,050	0	51,563

*The volumes listed here for incineration do not include the LSF quantities referenced in Table 13.

The volume of LLW managed by storage for decay has fluctuated over the last several years. In 1991, 38,219 cubic feet of LLW was managed by storage for decay, a 42.7% increase from the 1990 level of 26,779 cubic feet, but a 9.1% decrease from the 1989 level of 42,062 cubic feet. The "other" management methods continue to account for the same level of disposed LLW volume, less than 10% of the volume produced.

Table 15
1991 Volume and Activity of Liquid Waste Released to Municipal Sewers-By Generator Category
(cubic feet or curies)

Generator Category	Volume		Activity	
	Total	% of Total	Total	% of Total
Academic	5,556	70.1	1	1.2
Commercial	2,036	25.7	62	96.8
Government	330	4.2	1	2.0
Health	1	0.0	0	0.0
Utility	0	0.0	0	0.0
Total	7,923	100	64	100

Table 16
1991 Volume and Activity of Atmospheric Releases-By Generator Category
(cubic feet or curies)

Generator Category	Volume		Activity	
	Total	% of Total	Total	% of Total
Academic	0	0	0	0
Commercial	Negligible	0	65	100
Government	0	0	0	0
Health	0	0	0	0
Utility	0	0	0	0
Total	0	0	65	100

See explanation, page 19.

All the radionuclides in the Massachusetts LLW shipped for disposal in 1991 are segregated by category of half-lives in Tables 17 through 21. Half-lives range from 72 seconds (indium-114) to 47 billion years (rubidium-87). These tables list the total quantities of each radionuclide used by all licensees in the Commonwealth; some of these quantities amount only to a ten-thousandth of a curie.

Figure 13 illustrates the breakdown of LLW shipped for disposal, by half-life. Figure 14 shows the decay rate over 500 years of the radioactivity in the 1991 waste shipped for disposal.

Figure 13
LLW Shipped for Disposal-By Half-Life

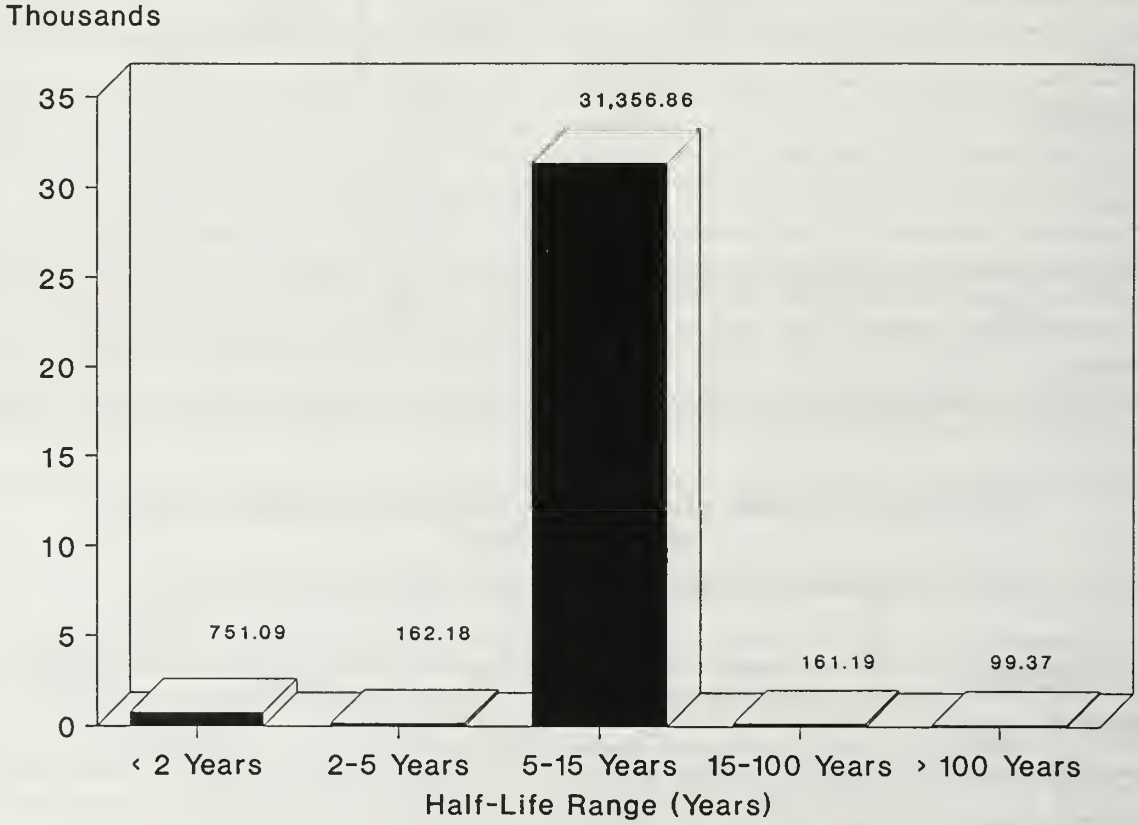


Figure 14
Decay Rate over 500 Years of 1991 LLW Shipped for Disposal

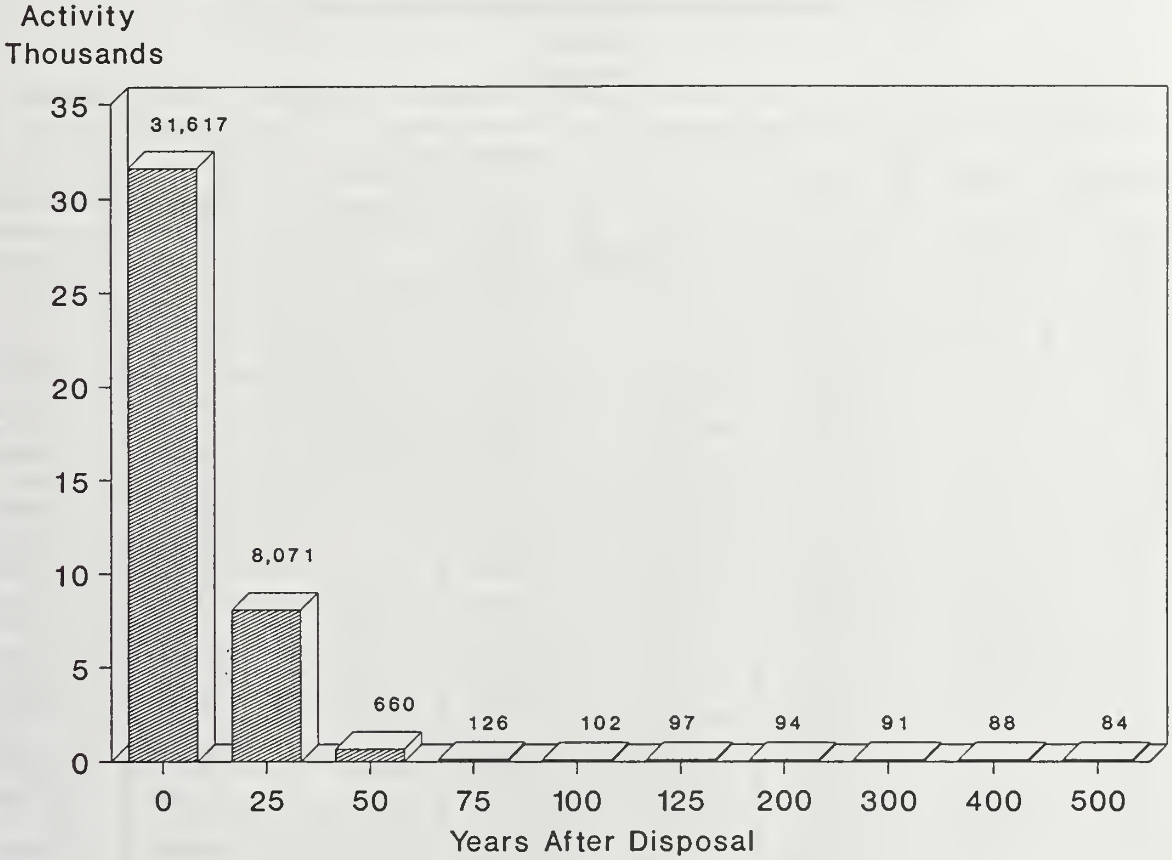


Table 17
1991 LLW Activity Shipped for Disposal-By Generator Category
Radionuclides with Half-Lives < 20 Days
(curies)

Radionuclide	Half-life[1]	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
In-114	72 s	0.000731	0.000000	0.000000	0.001200	0.000000	0.001931
Ag-108	3 m	0.000000	0.000005	0.000000	0.000000	0.000000	0.000005
Ga-68	68 m	0.000000	0.434635	0.000000	0.000000	0.000000	0.434635
Tc-99M	0.3	1.011000	0.211700	0.000000	30.800000	0.000000	32.022700

Table 17
1991 LLW Activity Shipped for Disposal-By Generator Category
Radionuclides with Half-Lives < 20 Days
(curies)
(continued)

Radionuclide	Half-life[1]	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
Pb-201	0.4	0.000000	0.001000	0.000000	0.000000	0.000000	0.001000
I-123	0.6	0.100450	0.000000	0.000000	0.010300	0.000000	0.110750
W-187	1.0	0.000000	0.000010	0.000000	0.000000	0.000000	0.000010
Br-82	1.5	0.000000	0.000040	0.000000	0.000000	0.000000	0.000040
La-140	1.7	0.000000	0.000000	0.000000	0.000000	0.149400	0.149400
Pb-203	2.2	0.000000	0.002000	0.000000	0.000000	0.000000	0.002000
I-125	2.5	0.452930	6.800213	0.200000	0.923895	0.000000	8.377038
Y-90	2.7	0.000000	0.051201	0.000000	0.000000	0.000000	0.051201
Au-198	2.7	0.000000	0.029000	0.000000	0.000000	0.000000	0.029000
Sb-122	2.7	0.000000	0.000010	0.000000	0.000000	0.000000	0.000010
Mo-99	2.8	0.000000	0.000003	0.000000	26.000000	0.000000	26.000003
In-111	2.8	0.100000	0.235467	0.000000	0.001000	0.000000	0.336467
Tl-201	3.0	0.100000	0.210206	0.000000	0.034000	0.000000	0.344206
Ga-67	3.3	0.000000	0.014052	0.000000	0.518000	0.000000	0.532052
Dy-166	3.4	0.000000	0.010000	0.000000	0.000000	0.000000	0.010000
Re-186	3.8	0.000000	0.073000	0.000000	0.000000	0.000000	0.073000
Xe-133	5.2	0.000000	0.021800	0.000000	10.000000	0.000000	10.021800
Au-196	6.2	0.000000	0.001600	0.000000	0.000000	0.000000	0.001600
I-131	8.0	0.100000	0.016227	0.000000	0.503030	1.746600	2.365857
Tl-202	12.2	0.000000	0.003097	0.000000	0.000000	0.000000	0.003097
Ba-140	12.7	0.000000	0.000000	0.000000	0.000000	8.137000	8.137000
P-24	14.0	0.000000	0.000400	0.000000	0.000000	0.000000	0.000400
P-32	14.3	0.650025	20.705303	0.000000	0.369500	0.000000	21.724828
Rb-86	18.7	0.003000	0.611827	0.000000	0.000000	0.000000	0.614827
Total		2.518246	29.432796	0 200000	69.160925	10.033000	111.344967

[1] s = seconds; m = minutes; undesignated = days

Table 18
1991 LLW Activity Shipped for Disposal-By Generator Category
Radionuclides with Half-Lives > 20 Days and < 90 Days
(curies)

Radionuclide	Half-life (Days)	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
P-33	25.3	0.000000	0.000001	0.000000	0.000000	0.000000	0.000001
Pa-233	27.0	0.000100	0.000000	0.000000	0.000000	0.000000	0.000100
Cr-51	27.8	0.138320	8.475755	0.000000	0.077200	132.839600	141.53087
Yb-169	32.0	0.000000	0.032750	0.000000	0.000000	0.000000	0.032750
Ce-141	32.4	0.000751	0.488867	0.000000	0.000000	0.994000	1.483618
Nb-95	35.2	0.101017	0.488454	0.000000	0.000000	0.815700	1.405171
Ru-103	39.3	0.0008[illegible]	0.268304	0.000000	0.000000	0.000000	0.269199
Fe-59	45.0	0.102217	0.484116	0.000000	0.000010	5.892920	6.479263
Hg-203	46.6	0.000000	0.094552	0.000000	0.000000	0.000000	0.094552
In-114m	70.8	0.000000	0.104560	0.000000	0.000000	0.000000	0.104560
Sr-89	50.5	0.000000	0.000000	0.000000	0.000000	1.466821	1.466821
Be-7	53.3	0.000000	0.002300	0.000000	0.000000	0.000000	0.002300
Ni-65	54.6	0.000000	0.572000	0.000000	0.000000	0.000000	0.572000
Sb-124	60.2	0.000000	0.000000	0.000000	0.000000	0.001461	0.001461
Tc-95m	61.0	0.000000	0.054400	0.000000	0.000000	0.000000	0.054400
Nb-91	50.5	0.000000	0.001000	0.000000	0.000000	0.000000	0.001000
Zr-95	54.6	0.000000	0.064104	0.000000	0.000000	0.204000	0.268104
Sr-85	64.8	0.000000	0.077311	0.000000	0.000000	0.000000	0.077311
Co-58	70.8	0.100100	0.216096	0.000000	0.000000	31.034960	31.351156
Ir-192	74.0	0.100000	21.015400	0.000000	1.315500	0.000000	22.430900
Co-56	78.8	0.000000	0.000005	0.000000	0.000000	0.000000	0.000005
Sc-46	83.8	0.000000	0.087943	0.000000	0.002000	0.000000	0.089943
S-35	87.2	1.304111	320.814264	0.000000	0.145968	0.000000	322.26434
Total		1.847511	353.342182	0.000000	1.540678	173.249462	529.97983

The radionuclides abbreviated in Tables 17 through 21 are listed in Appendix C.

Table 19
1991 LLW Activity Shipped for Disposal-By Generator Category
Radionuclides with Half-lives > 90 Days and < 180 Days
(curies)

Radionuclide	Half-life (Days)	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
Y-88	107	0.000000	0.034322	0.000000	0.000000	0.000000	0.034322
Ta-182	115	0.00[illegible]000	0.000010	0.000000	0.000000	0.000000	0.001010
Sn-113	115	0.000846	0.487832	0.000000	0.008520	0.000000	0.497198
Te-123m	120	0.000000	0.000101	0.000000	0.000000	0.022181	0.022282
Se-75	120	0.100000	0.166000	0.000000	0.000100	0.000000	0.266100
Ce-139	137	0.000100	0.003300	0.000000	0.000000	0.000000	0.003400
Dy-159	144	0.000000	0.023000	0.000000	0.000000	0.000000	0.023000
Cm-242	163	0.000000	0.000000	0.000000	0.000000	0.000364	0.000364
Ca-45	163	0.137830	1.172895	0.000000	0.010266	0.000000	1.320991
Total		0.239776	1.887460	0.000000	0.018886	0.022545	2.168667

Table 20
1991 LLW Activity Shipped for Disposal-By Generator Category
Radionuclides with Half-lives > 180 Days and < 5 Years
(curies)

Radionuclide	Half-life[1]	Generator Category				Utility	Total
		Acad	Comm	Govt	Health		
Au-195	183 d	0.000000	0.049226	0.000000	0.000000	0.000000	0.049226
Cd-109	288 d	0.100000	21.715270	0.000000	0.001025	0.000000	21.816295
Zn-65	244 d	0.002160	0.982261	0.000000	0.000040	9.572762	10.557223
Ag-110m	250 d	0.000035	0.069542	0.000000	0.000000	2.710364	2.779941
Ge-68	271 d	0.100920	7.558613	0.000100	0.002816	0.000364	7.662813
Ce-144	284 d	0.000100	0.010004	0.000000	0.000000	7.796235	7.806339
Ge-68	288 d	0.000000	0.274124	0.000000	0.000000	0.000000	0.274124
Mn-54	313 d	0.000120	0.310855	0.000000	0.000000	63.693050	64.004025
Sm-145	340 d	0.000000	0.000101	0.000000	0.000000	0.000000	0.000101
Ru-106	368 d	0.000000	0.000400	0.000000	0.000000	0.000000	0.000400
Cd-109	464 d	0.000001	0.328785	0.000000	0.000000	0.000000	0.328786
Cs-134	2.06 y	0.000000	0.071983	0.000000	0.000000	21.237103	21.309086
Na-22	2.6 y	0.014887	0.779074	0.000000	0.006122	0.000000	0.800083
Pm-147	2.62 y	0.000000	0.036966	0.000000	0.000000	0.000000	0.036966
Fe-55	2.7 y	0.005164	1.346505	0.000000	0.012000	138.666100	140.029769
Tl-204	3.78 y	0.001000	0.000000	0.000000	0.000000	0.000000	0.001000
Total		0.224387	33.533740	0.000100	0.022003	243.675978	277.456208

[1] d = days; y = years

Table 21
1991 LLW Activity Shipped for Disposal-By Generator Category
Radionuclides with Half-lives > 5 Years
(curies)

Radionuclide	Half-life (Years)	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
Co-60	5	0.006100	1.214344	0.000300	0.000022	270.778800	271.999566
Eu-154	9	0.000000	0.001000	0.000000	0.000000	0.000000	0.001000
Eu-152	5	0.001100	0.000100	0.000000	0.000000	0.000000	0.001200
Kr-85	10	0.000000	49.424140	0.000000	0.000000	0.000000	49.424140
Ba-133	10	0.000250	2.388057	0.000000	0.000119	0.000000	2.388426
H-3	12	30.568349	30978.19080	0.000077	0.492857	23.263844	31032.515929
Pu-241	17	0.000000	0.000000	0.000000	0.000000	0.531690	0.531690
Pm-145	17	0.000000	0.000001	0.000000	0.000000	0.000000	0.000001
Cm-234/44	18	0.000000	0.000000	0.000000	0.000000	0.000877	0.000877
Sr-90	29	0.010102	20.275571	0.000000	0.010000	0.442902	20.738575
Cs-137	30	0.001100	42.854355	0.001000	0.000150	66.205300	109.061905
Bi-207	38	0.000000	0.000005	0.000000	0.000000	0.000000	0.000005
Pu-238	38	0.000000	0.010000	0.000000	0.000000	0.003688	0.013688
Ni-59	38	0.000000	15.700812	0.400000	0.000100	7.601810	23.702722
Am-241	432	0.000101	0.663406	0.000000	0.000000	0.009162	0.672669
Ho-166m	1200	0.000000	0.010000	0.000000	0.000000	0.000000	0.010000
Ra-226	1600	0.000002	0.000275	0.000000	0.000000	0.000000	0.000277
C-14	5730	0.718821	74.999486	0.000020	0.061442	0.310320	76.090089
Am-243	7380	0.000100	0.000000	0.000000	0.000000	0.000000	0.000100
Pu-239/40	24065	0.000000	0.000000	0.000000	0.000000	0.006137	0.006137
Ni-59	75000	0.000000	0.000000	0.000000	0.000000	0.000728	0.000728
Th-230	77000	0.000100	0.000000	0.000000	0.000000	0.000000	0.000100
Tc-99	213000	0.177900	0.632064	0.000000	0.000801	0.000000	0.810765
Pb-202	300000	0.000000	0.000200	0.000000	0.000000	0.000000	0.000200
Pu-242	376300	0.000100	0.000000	0.000000	0.000000	0.000000	0.000100
Cl-36	3010000	0.027359	0.033515	0.000000	0.000136	0.000000	0.061010
Pd-107	6500000	0.000000	0.001000	0.000000	0.000000	0.000000	0.001000

Table 21
1991 LLW Activity Shipped for Disposal-By Generator Category
Radionuclides with Half-lives > 5 Years

(curies)
(continued)

Radionuclide	Half-life (Years)	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
I-129	15900000	0.000000	0.001543	0.001000	0.000000	0.030224	0.032767
U-236	23415000	0.000100	0.000000	0.000000	0.000000	0.000000	0.000100
U-238	4468000000	0.002010	21.646624	0.000000	0.000000	0.000000	21.648634
Th-232	14050000000	0.000000	0.020600	0.000000	0.000000	0.000000	0.020600
Rb-87	47000000000	0.000000	0.001000	0.000000	0.000000	0.000000	0.001000
Total		31.51359	31208.07	0.402397	0.565626	369.185483	31609.736000

6. Summary of 1990 Survey Data

Information on 1990 LLW activities was also collected in the 1991 survey, due to the fact that the 1990 survey had been distributed late in 1990 and, therefore, captured only six months of actual and six months of projected waste disposal data. In 1990, 42,240 cubic feet of LLW with a total activity of 111,082 curies was shipped for disposal. Of the 111,082 curies, 110,252 curies resulted from the production of radiopharmaceuticals and radioisotope labeled research compounds. Of that quantity, 102,881 curies were packaged as Class B for disposal. Figures 15 through 17 summarize the Massachusetts data for 1990.

Figure 15
1990 LLW Volume Shipped for Disposal-By Disposal Classification
(cubic feet)

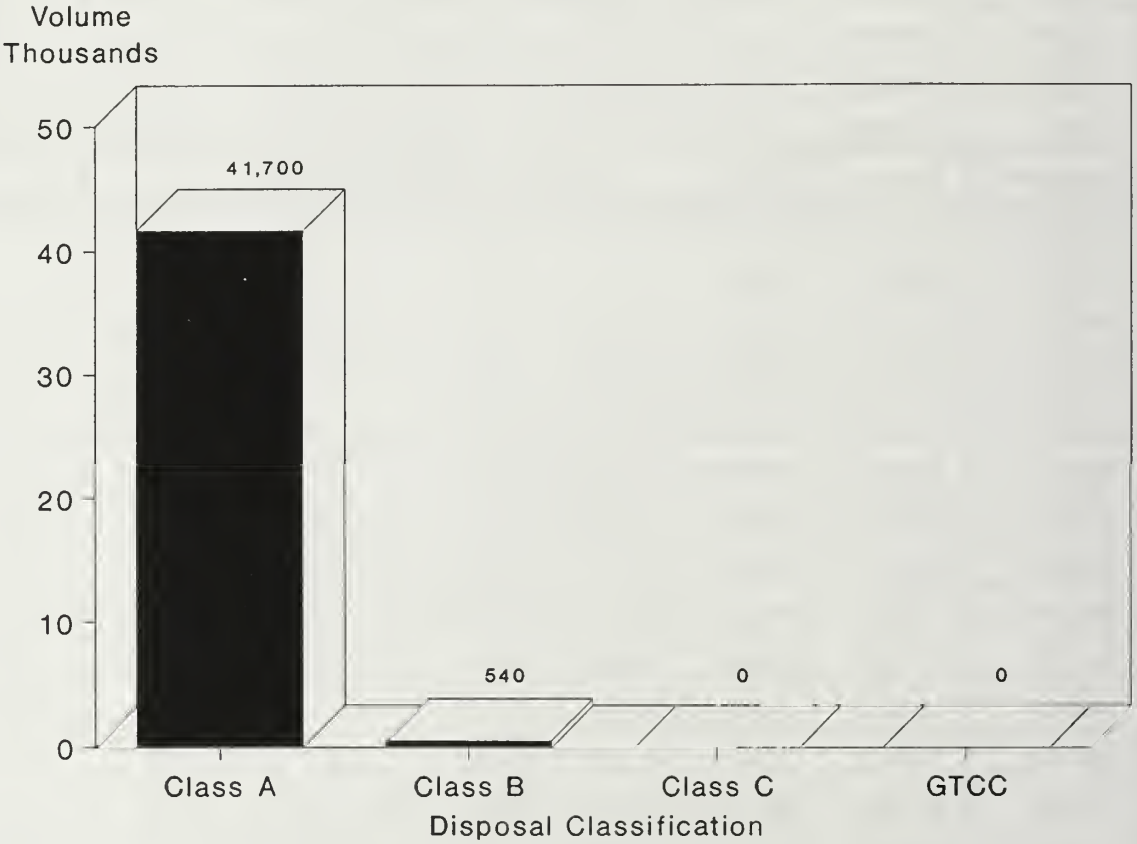


Figure 16
1990 LLW Volume Shipped for Disposal-By Generator Category
(cubic feet)

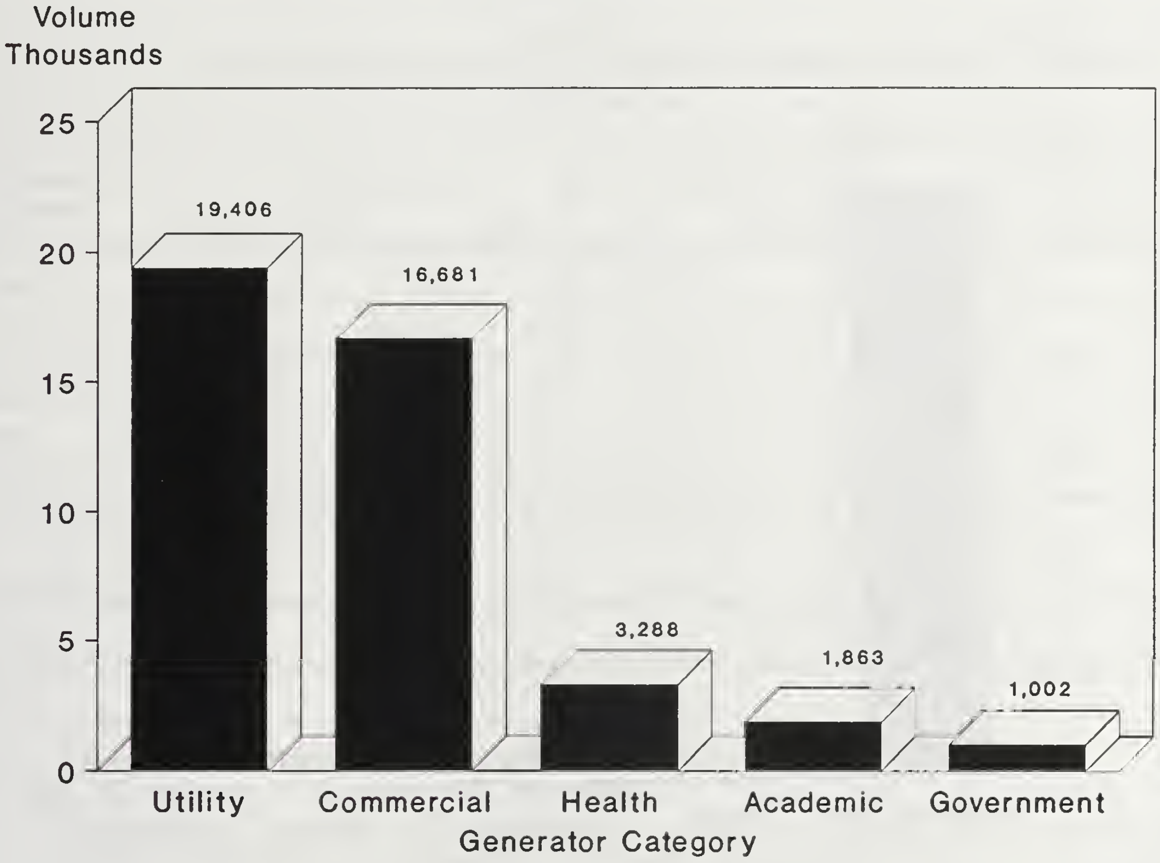
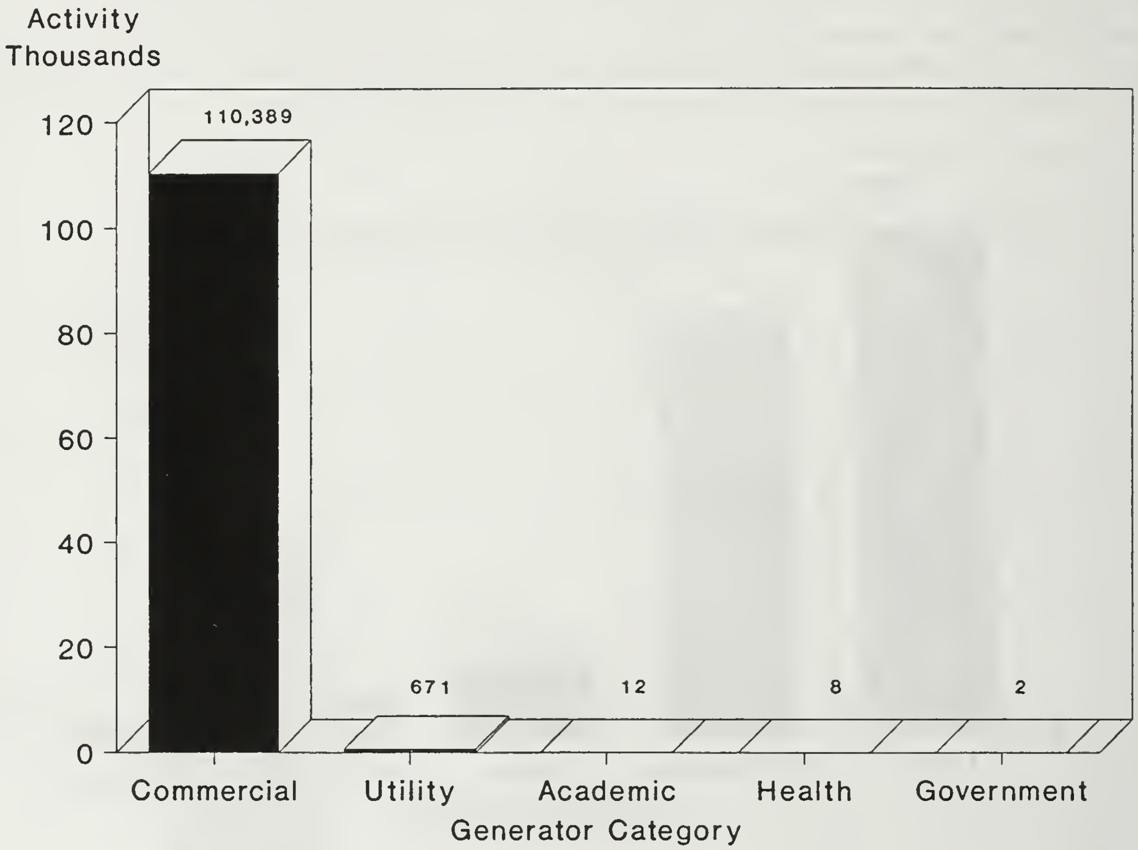


Figure 17
1990 LLW Activity Shipped for Disposal-By Generator Category
(curies)



7. Characteristics of 1990 Massachusetts LLW

Table 22
1990 LLW Volume Shipped For Disposal By Generator Category
(cubic feet)

Generator Category	Volume			Volume		Activity	
	Class A	Class B	Class C	Total	% of Total	Curies	% of Total
Academic	1,863	0	0	1,863	4.4	12	0.0
Commercial	16,471	210	0	16,681	39.5	110,389	99.4
Government	1,002	0	0	1,002	2.4	2	0.0
Health	3,283	5	0	3,288	7.8	8	0.0
Utility	19,081	325	0	19,406	45.9	671	0.6
Total	41,700	540	0	42,240	100	111,082	100
% of Total	98.7	1.3	0.0	100.0			

Table 23
1990 LLW Volume Managed By Alternate Methods
(cubic feet)

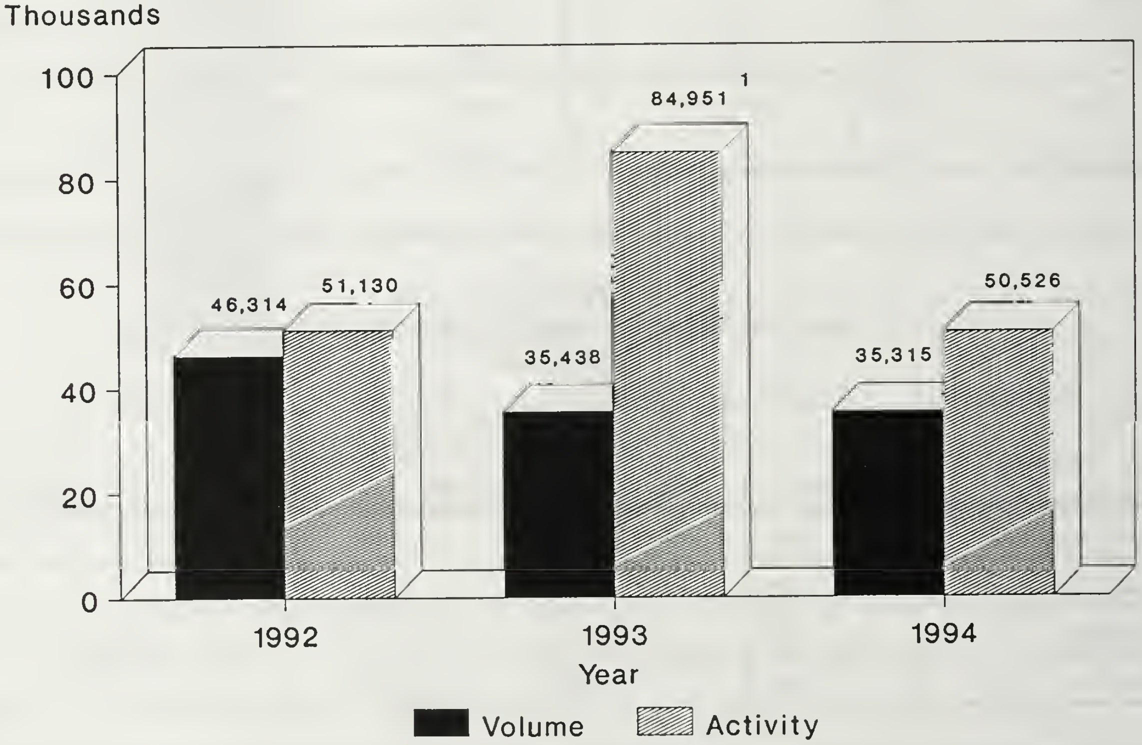
Method	Generator Category				
	Academic	Commercial	Health	Government	Utility
Store For Decay	5,309	5,753	14,490	1,027	0
Sewer Discharge	577	1,345	285	0	0
Incineration	1,452	845	2,413	0	0
Other[1]	1,178	815	2,009	0	0

[1] "Other" represents waste management activities besides those listed above, such as atmospheric release, recycling, and return to the manufacturer/supplier.

8. Volume and Activity Projections, 1992-1994

Figure 18 summarizes generator projections for volume and activity to be shipped for disposal from 1992 through 1994. These projections are consistent with past years' trends toward declining volumes requiring licensed disposal, and fluctuations in the levels of activity. The Commonwealth's Management Board has projected that LLW volume requiring disposal in a licensed facility will level off to approximately 30,000 to 35,000 cubic feet per year, not including LLW which will result from the decommissioning of the Yankee Atomic nuclear power plant in Rowe. Based upon the data supplied by radioactive materials licensees, the Board's forecast of the activity of waste requiring disposal shows the same variations as illustrated for the three years shown in Figure 18.

Figure 18
LLW Volume and Activity to be Shipped for Disposal-Projections 1992-1994
(cubic feet or curies)



[1] The projected increase in activity in 1993 includes the anticipated shipment by Boston Edison of 225 cubic feet of activated metal components amounting to 50,000 curies.

9. 1990 and 1991 LLW Shipment Information

The following four tables provide information on LLW shipments as reported by generators transporting LLW during 1990 and 1991. Shipments shown in Tables 24 and 25 are segregated by the three basic types of packaging required by U.S. Department of Transportation (DOT) and NRC regulations. These are "Type A," "Type B" and "strong tight containers." This third category is commonly called "LSA" packaging because it is used to transport waste in which the radioactivity in the package is uniformly distributed, and the waste has a low average concentration (i.e., "Low Specific Activity"-- LSA) per gram of material. Type A and Type B packages bear no correlation to the NRC "Class A" and "Class B" waste disposal classifications.

Table 24
1990 LLW Shipments-By Type of Shipment and Generator Category

Type of Shipment	Generator Category					Total
	Academic	Commercial	Government	Health	Utility	
LSA	11	124	0	49	78	262
Type B	54	169	0	58	1	285
Type B	0	20	0	1	0	21
Route Controlled	0	0	0	0	0	0
Total	65	313	0	108	82	568

Table 25
1991 LLW Shipments-By Type of Shipment and Generator Category

Type of Shipment	Generator Category					Total
	Academic	Commercial	Government	Health	Utility	
LSA	4	103	0	89	89	256
Type A	60	193	1	107	5	366
Type A	0	15	0	0	5	15
Route Controlled	0	0	0	0	0	0
Total	64	312	1	196	64	637

Tables 26 and 27 refer to shipments made to brokers and processors as well as directly to licensed disposal sites. The data in Tables 28 and 29 was reported by brokers or processors of LLW that service

Table 26
1990 LLW Shipment Destination-By Generator Category

Generator Category	Destination		Total Shipments
	Broker\Processor	Directly to Disposal Site	
Academic	69	0	69
Commercial	284	41	325
Government	2	0	2
Health	113	13	126
Utility	41	41	82
Total	472	95	568

Table 27
1991 LLW Shipment Destination-By Generator Category

Generator Category	Destination		Total Shipments
	Broker\Processor	Directly to Disposal Site	
Academic	63	1	64
Commercial	270	42	312
Government	1	0	1
Health	193	[illegible]	196
Utility	21	43	64
Total	548	89	637

Massachusetts generators. A "trip" is defined as the length of time spent or distance travelled by a vehicle while in Massachusetts. A "pickup" is a stop made by a vehicle during a trip for the purpose of loading LLW. A comparison of the total number of trips to the total number of pickups reveals that a single vehicle will enter Massachusetts and pick up LLW from several generators before leaving the state. This procedure routinely occurs monthly. In addition, the "total number of pickups" reported by brokers are less than reported shipments using brokers shown in Tables 26 and 27. These differences are due to reporting inconsistencies, including counting each container as a shipment in some cases, and counting trips in which radioactive material was returned to a supplier. The latter practice is routinely followed by hospitals that return short-lived radiopharmaceuticals to the supplier if they are not used.

Table 28
1990 LLW Broker Trip Data

Total Trips	Total Travel Time (hours)	Total Distance Traveled (miles)	Total Number of Pickups	Total Volume Picked Up (cubic feet)	Total Activity Picked Up (curies)
56	321	13,692	297	15,575	14.610

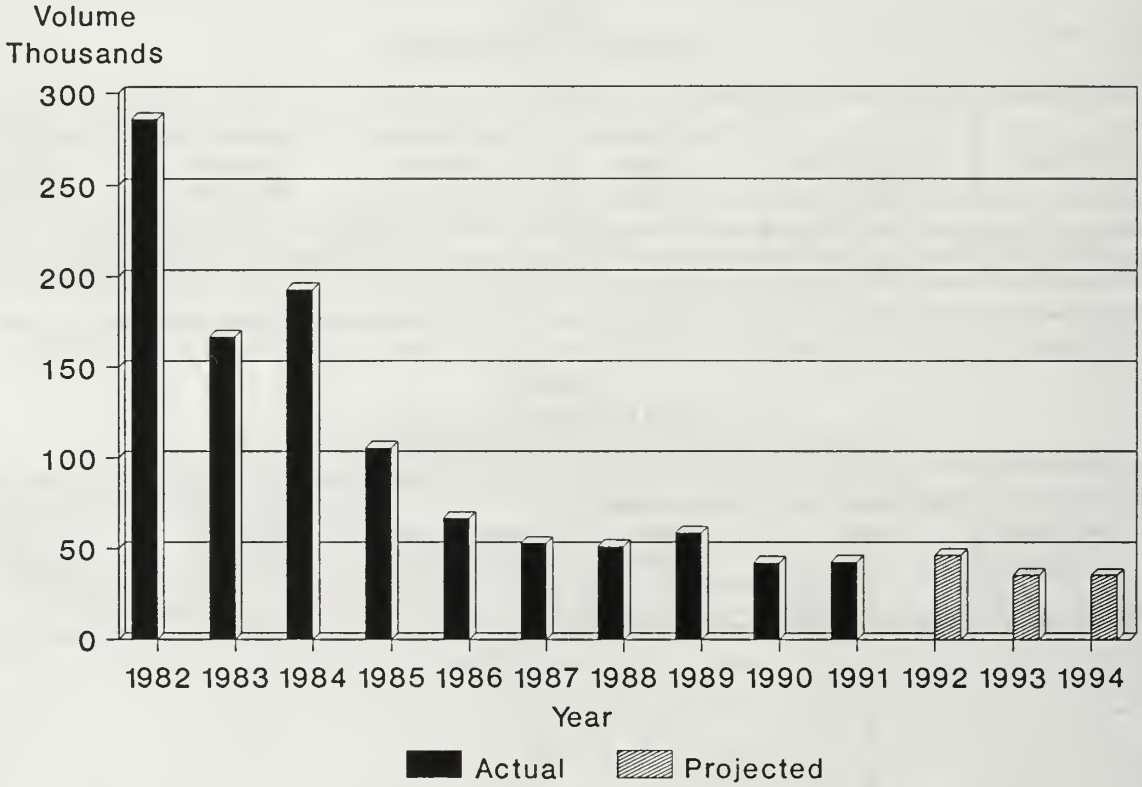
Table 29
1991 LLW Broker Trip Data

Total Trips	Total Travel Time (hours)	Total Distance Traveled (miles)	Total Number of Pickups	Total Volume Picked Up (cubic feet)	Total Activity Picked Up (curies)
59	380	15,190	379	15,225	70.736

10. Evaluating the 1991 Data for Policy-Making Purposes

The 1991 data show a continuing decline in volume of LLW shipped for licensed disposal by Massachusetts generators. Although LLW production was nearly the same in 1989 and 1991, the amount of waste shipped for disposal decreased by 18% and 27% in 1990 and 1991, respectively, from that which was shipped in 1989.

Figure 19
Historical and Projected LLW Volume Shipped for Disposal
(cubic feet)



The decrease in waste shipped for disposal in 1990 and 1991 is a continuation of a trend, shown in Figure 13, that coincided with the passage of the federal Low-Level Radioactive Waste Policy Act in 1980, and continued through the adoption, in 1985, of amendments to the federal Act that added surcharges to fees for waste disposal, ranging from $20 to $120 per cubic foot.

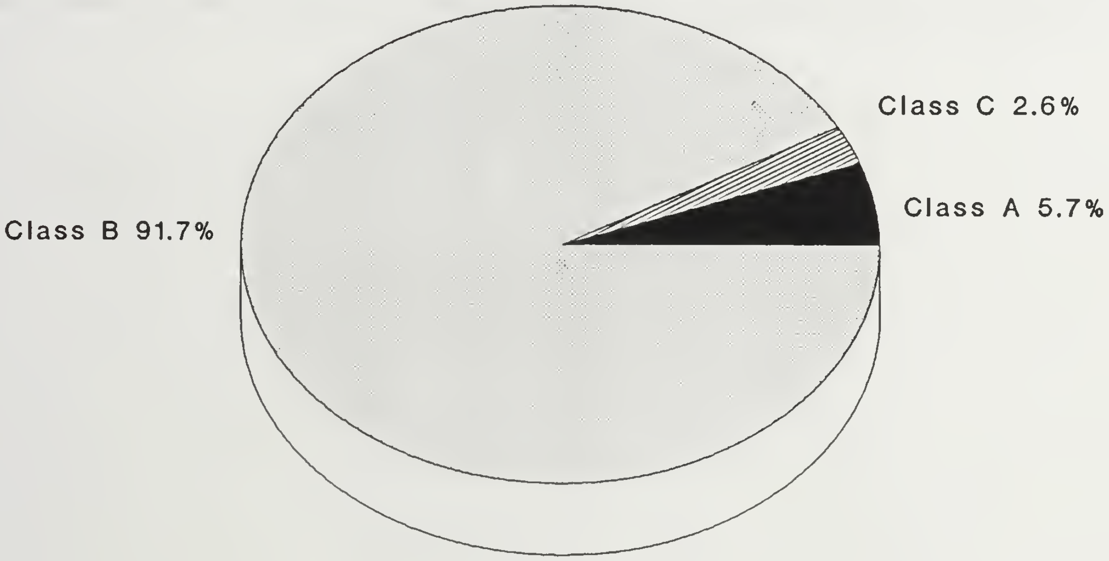
The amount of activity shipped for disposal in the last two years (111,082 curies in 1990 and 32,531 curies in 1991) has varied from previous years, as shown in Table 30. These fluctuations are expected to continue, depending upon the shipping practices and operations of individual LLW generators, in particular, the nuclear power plants that periodically make large activity shipments following routine power outages.

Table 30
Historical and Projected LLW Activity Shipped for Disposal
(curies)

1988	1989	1990	1991	1992	1993	1994
10,070	57,386	111,082	32,531	51,130	89,951	50,526

Of the three NRC disposal classes, Class A waste continues to be the largest LLW class shipped for disposal, comprising 98.7% and 97.9% of the Massachusetts waste sent to the four licensed disposal facilities in 1990 and 1991, respectively. Though Class A is the dominant waste class, it usually contains a small percentage of the total activity. As shown in Figure 20, the majority of activity in 1991 (91.7%), was contained in Class B waste; Class A waste accounted for 5.7%; and Class C waste accounted for only 2.6%.

Figure 20
1991 LLW Activity Shipped for Disposal
by Disposal Class



Outlook

Based on the continuing reduction in waste shipped for disposal over the past three years, and information supplied by the generators, the Management Board has predicted that the annual Massachusetts LLW volume requiring disposal in a licensed LLW disposal facility will level off at approximately 30,000 cubic feet by the mid-1990's. However, the Board will continue to request generator volume projections in order to confirm and update its projections.

The 1991 survey data also reveal the reliance generators have placed on brokers and processors to collect, transport, and treat LLW produced in Massachusetts. The use of brokers and processors may continue at approximately the same rate in future years. Or, it may decline as generators store more waste on site because of the end of access to the three major disposal sites in South Carolina, Nevada and Washington. The Management Board has taken the steps necessary to retain access to South Carolina's site at Barnwell for 18 months (January, 1993 through June, 1994), after federal law allows the three sites to close their doors to out-of-region waste on December 31, 1992. After the Barnwell site availability ceases, all Massachusetts generators will be forced to store their LLW on site. The Management Board will continue to survey generator's use of brokers and processors, to ascertain whether waste produced in the Commonwealth will be shipped to a treatment facility, and then shipped back to the generator for on-site storage.

11. Appendices

Appendix A: Massachusetts Radioactive Materials Licensees

Appendix A is a list of all surveyed radioactive materials users in 1991.

Appendix B: 1991 Massachusetts LLW Generators who Shipped for Disposal

Appendix B lists all 1991 LLW generators by the percentages of volume and activity shipped for disposal.

Appendix C: Symbols for all Radionuclides used in Massachusetts

Appendix C lists alphabetically all radionuclides used by Massachusetts licensees. Some nuclides have several different isotopes; they are not included here, but can be found in Tables 17 through 21.

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Barnstable County											
Falmouth	Falmouth Hospital	0	0	0	0	0	S: Nuclear medicine imaging	Storage for decay	0		
Falmouth	Marine Research, Inc.	0	0	0	0	0	O: License termination in progress				
Hyannis	Cape Cod Hospital	0	0	0	0	0	S: Nuclear medicine imaging	Storage for decay	0		
Hyannis	Cardiac Imaging Inc.	0	0	0	0	0	S: Nuclear medicine imaging	Storage for decay	0		
Mashpee	AGM Marine Contractors, Inc.	0	0	0	0	0	SS: Analysis of soil samples				
Woods Hole	Marine Biological Laboratory	52	0	0	52	0.09	R: Basic biomedical research	Storage for decay	0	55 Gallon Steel Drum	1
Woods Hole	U.S. Department of the Interior, U.S. Geological Survey	0	0	0	0	0	SS: Analysis of soil samples				
Woods Hole	Woods Hole Oceanographic Institute	40.1	0	0	40.1	0.1165	R: Biological & chemical research and education	Storage for decay	32	30 Gallon Steel Drum	2
Berkshire County											
Adams	Pfizer Inc./MSP Division	0	0	0	0	0	SS: Measurement of slurry density				
Dalton	Crane & Co., Inc.	0	0	0	0	0	SS: Measurement of paper thickness				
Great Barrington	Fairview Hospital	0	0	0	0	0	S: Nuclear medicine	Storage for decay			

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(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Lee	Capfilm, Inc.	0	0	0	0	0	SS: Measurement of plastic film				
Lenox	Lenox Institute of Water Technology, Inc.	0	0	0	0	0	SS: Gas chromatography				
North Adams	North Adams Regional Hospital	0	0	0	0	0	S: Nuclear medicine imaging		0		
North Adams	Sprague Electric Company	8.02	0	0	8.02	0.00191	P: Manufacture of electronic components		0	30 Gallon Steel Drum	2
Pittsfield	A.H. Rice Corporation	0	0	0	0	0	SS: Radium in storage				
Pittsfield	Beloit Corp. Research Center	0	0	0	0	0	SS: Measuring device				
Pittsfield	Berkshire Medical Center	0	0	0	0	0	C: Nuclear medicine imaging	Storage for decay	0		
Pittsfield	General Electric Aerospace	7.5	0	0	7.5	0.000398	O: Lab Decommissioned Presently Using Sealed Sources Only		0	55 Gallon Steel Drum	1
Pittsfield	Hillcrest Hospital	0	0	0	0	0	S: Medical diagnostic operation				
Pittsfield	J.H. Maxymilliam, Inc.	0	0	0	0	0	SS: Troxler nuclear gauges				
Pittsfield	Scalise-Knysh Associates Inc.	0	0	0	0	0	SS: Measure density of soils and pavement				
Williamstown	Williams College	0	0	0	0	0	R: Teaching and research		4		

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Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Bristol County											
Attleboro	Sturdy Memorial Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Fall River	Charlton Memorial Hospital	0	0	0	0	0	C: Nuclear medicine	Storage for decay	0		
Fall River	Roentngen Associates of Fall River	0	0	0	0	0	O: License terminated				
Fall River	St. Anne's Hospital	0	0	0	0	0	S: Nuclear Medicine				
Mansfield	Clinical Science Lab	0	0	0	0	0	S: In-vitro diagnostic testing	Storage for Decay	0		
New Bedford	Prym/Dritz Corporation	0	0	0	0	0	SS: Storage of ionotion bars containing radium				
New Bedford	Saint Luke's Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
North Attleboro	Mallinckrodt Medical Inc.	20.05	0	0	20.05	.0000006	P: Manufacture and distribution of radiopharmeceutic products	Compaction, incineration, absorption	0	30 Gallon Steel Drum	15
North Dartmouth	The Office of Drs. Horan and Jaslow	0	0	0	0	0	O: License terminated				
North Dartmouth	University of Massachusetts, Dartmouth	0	0	0	0	0	R/S: Research and teaching	Storage for decay	0		

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Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Norton	Wheaton College	0	0	0	0	0	R/S: Research and teaching	Storage for decay, sorting\ segregation	4		
Raynham	Defeo, Walt & Assoc., Inc.	0	0	0	0	0	SS: Nuclear density meter to determine density of construction materials				
Somerset	New England Power Co.	0	0	0	0	0	SS: Used for coal and ash silo level detection and chute plugage detection				
South Attleboro	State Line Scrap Co., Inc.	0	0	0	0	0	SS: X-ray fluorescent analyzer for metallurgical application				
Taunton	Morton Hospital and Medical Center	0	0	0	0	0	S: Diagnostic imaging services				
Taunton	Tibbetts Engineering Corp.	0	0	0	0	0	O: License terminated				
Dukes County											
Oak Bluffs	Martha's Vineyard Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Vineyard Haven	Kent A. Healy, P.E.	0	0	0	0	0	O: License terminated				
Essex County											
Amesbury	Amesbury Hospital	0	0	0	0	0	S: Diagnostic imaging	Storage for decay	0		

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Andover	Carroll Engineers, Inc.	0	0	0	0	0	SS: Industrial radiography				
Andover	Digital Equipment Corporation	4.01	0	0	4.01	0.25009	O: License terminated		0	7A Drum	1
Andover	Eisai Research Institute	15	0	0	15	0.015	R: R & D using Biological Assays	Incineration, storage for decay	0	55 Gallon Steel Drum	4
Andover	Raytheon Company	0	0	0	0	0	SS: Sealed sources for out-of-state use				
Beverly	Applied Infrared Technologies, Inc.	0	0	0	0	0	SS: Roof moisture testing				
Beverly	Autogen Instrumentation, Inc. No response to survey										
Beverly	Beverly Hospital No response to survey										
Beverly	New England Biolabs	0	0	0	0	0	R: Biotechnology research and development	Storage for decay	0		
Beverly	Salem and Beverly Water Supply Board	0	0	0	0	0	SS: Potable water analysis				
Beverly	Stocker & Yale, Inc.	0	0	0	0	0	SS: Used in manufacturing processes				
Beverly	Varian Associates	61.3	0	0	61.3	76.00227	P: Manufacture and sale of electron tubes		37.5	55 Gallon Drum	3

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(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Danvers	Abiomed	0	0	0	0	0	SS: Used in x-ray fluorescent research				
Danvers	Amicon Division, W.R. Grace & Co.	0	0	0	0	0	P: Measurement of properties during manufacturing processes.	Storage for decay			
Danvers	Diagnostic Management Services	0	0	0	0	0	C: Nuclear medicine studies	Storage for decay	0		
Danvers	GTE Products Corp.	0	0	0	0	0	O: License terminated				
Danvers	Hunt Center For Emergency and Ambulatory Care	0	0	0	0	0	C: Diagnostic nuclear medicine and clinical chemistry	Storage for decay	0.5		
Gloucester	Addison Gilbert Hospital	0	0	0	0	0	C: Clinical Nuclear Medicine	Store for decay	0		
Gloucester	U.S. Commerce, Marine Fisheries	0	0	0	0	0	SS: Chemical analysis Instrument				
Hathorne	Charles T. Morgan Co., Inc.	0	0	0	0	0	SS: Occasional demonstrations of portable analysis units				
Haverhill	Hale Hospital	0	0	0	0	0	C: Diagnostic and therapeutic nuclear medicine	Storage for decay	1		52
Haverhill	IMI, Inc.	0	0	0	0	0	SS: X-ray of multilayer PC boards				
Ipswich	Bio-Nuclear Measurements, Inc.	0	0	0	0	0	O: License terminated				

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(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Lawrence	Lawrence General Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Lawrence	MA DEP	0	0	0	0	0	SS: Calibration sources				
Lawrence	Silverman Brothers, Inc.	0	0	0	0	0	SS: Kevex analyzer				
Lynn	AtlantiCare Medical Center	0	0	0	0	0	C: Diagnostic nuclear medicine				
Lynn	General Electric Aircraft Engines No response to survey										
Lynn	Mt. Pleasant Hospital No response to survey						O: License terminated; hospital closed				
Methuen	Holy Family Hospital & Medical Center	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Middleton	F.X. Masse Assoc., Inc.	0	0	0	0	0	SS: Instrument calibration				
Newburyport	Anna Jaques Hospital	0	0	0	0	0	S: Diagnostic imaging				
North Andover	AT&T Network Systems	0	0	0	0	0	P: Telecommunications		0		
North Andover	Borden Packaging and Industrial Products	0	0	0	0	0	SS: Thickness and density measuring devices				
North Andover	Brooks School	0	0	0	0	0	R: Uptake experiments				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
North Andover	Mediq Imaging Services, Inc.	0	0	0	0	0	S: Diagnostic imaging				
North Andover	RTS Technology	0	0	0	0	0	P: Manufacture of sealed sources		22.5		
Peabody	J.B. Thomas Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Salem	EG&G Inc.	21.3	0	0	21.3	0.890103	P: Development & manufacture of electron tubes	Compaction	0	55, 30 & 8 Gallon Steel Drum	5
Salem	MA Department of Fisheries, Wildlife & Environmental Law Enforcement	0	0	0	0	0	SS: Gas chromatography				
Salem	New England Chromachem	0	0	0	0	0	SS: Gas chromatography				
Salem	New England Power Co.	0	0	0	0	0	SS: Used to monitor coal flyash levels and monitor for plug chutes				
Salem	Salem Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
West Newbury	Women's Health Care, P.C.	0	0	0	0	0	SS: Bone density measurements				
Franklin County											
Franklin	Digital Equipment Corp.	0	0	0	0	0	SS: Go/No-Go testing of ECL Sran memory devices				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Franklin	Thermo Environmental Instruments	0	0	0	0	0	SS: Instruments				
Greenfield	Dr. William Hester	0	0	0	0	0	O: License termination in progress				
Greenfield	Franklin Medical Center	2	0	0	2	0.000402	C: Nuclear medicine diagnostics and laboratory testing	Storage for decay	0		1
Rowe	Yankee Atomic Electric Co.	5557	0	240	5797	89.722	P: Electricity and laboratory services	Compaction	255	Poly HIC, Metal Box In Overpack, DOT Spec 17H, 30 Gal, 55 Gal Metal Box	16
South Deerfield	John E. Cain Co.	0	0	0	0	0	O: License terminated				
Hampden County											
Chicopee	College Of Our Lady Of The Elms	0	0	0	0	0	R/S: Teaching & research		0		
Holyoke	Holyoke Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine and clinical chemistry	Storage for decay	0		
Holyoke	Providence Hospital No response to survey										
Ludlow	F&J Construction Co.	0	0	0	0	0	SS: Moisture density gauge				
Ludlow	Jack Goncalves & Sons, Inc.	0	0	0	0	0	SS: Density gauge				

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(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Ludlow	Ludlow Hospital	0	0	0	0	0	C: Diagnostic and therapeutic nuclear medicine	Storage for decay, return to supplier	0		
Palmer	Tambrands, Inc.	0	0	0	0	0	SS: Mass thickness gauge				
Palmer	Wing Memorial Hospital	0	0	0	0	0	C: Nuclear medicine imaging	Storage for decay	0		
Springfield	Allied Testing Labs	0	0	0	0	0	SS: Analysis of moisture/density of soil and asphalt				
Springfield	Baystate Medical Center	0	0	0	0	0	C: Nuclear medicine, radiation therapy, radioimmunoassays	Storage for decay	0		
Springfield	Cameo Diagnostic Center, Inc.	0	0	0	0	0	S: Medical diagnostic				
Springfield	Interstate Nuclear Services	207	0	0	207	1.637906	P: Decontamination laundry	Incineration, compaction	0	B-25 Wooden	2
Springfield	Johnson Foils, Inc.	0	0	0	0	0	SS: Thickness measurement				
Springfield	Mercy Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Springfield	Monsanto Chemical Co.	0	0	0	0	0	SS: Industrial measurement and gauging				
Springfield	Novacor Chemicals, Inc.	0	0	0	0	0	SS: Density and water level measurement				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Springfield	Springfield Department of Public Works No response to survey										
Springfield	Springfield Technical Community College	0	0	0	0	0	SS: Gas chromatography				
Westfield	Noble Hospital No response to survey										
Westfield	Springfield Municipal Water Works	0	0	0	0	0	SS: Gas chromatography				
Westfield	Tighe & Bond, Inc.	0	0	0	0	0	SS: Gas chromatography				
Hampshire County											
Amherst	Amherst College	0	0	0	0	0	R/S: Research and teaching	Storage for decay	0		
Amherst	Univ. of MA, Amherst	120	0	0	120	0.14484	R/S: Research and teaching	Storage for decay	0	55 Gallon Steel Drum	1
Northampton	Cooley Dickinson Hospital	0	0	0	0	0	C: Nuclear medicine imaging	Storage for decay	0		
Northampton	Smith College	15	0	0	15	0.019215	R/S: Research and teaching	Compaction, absorption	0	55 Gallon Steel Drum	1
Northampton	V.A. Medical Center	0	0	0	0	0	SS: Medical diagnostic imaging				
South Hadley	Mount Holyoke College	0	0	0	0	0	R/S: research and teaching	Storage for decay	0		

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Middlesex County											
Acton	ENSR Consulting & Engineering No response to survey										
Arlington	Symmes Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Ashland	Kidde-Fenwal Inc.	0.67	0	0	0.67	0.021	P: Smoke detectors		8.01	5 Gallon Pail	2
Ayer	Nashoba Community Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Bedford	CIS-US Inc.	7.5	0	0	7.5	1.4315	P: Manufacture and distribution of radiopharmaceutical	Storage for Decay	12		1
Bedford	ENRM Veterans Hospital	45	0	0	45	4.9148	C/R: Nuclear medicine and research		0	55 Gallon and 5 Gallon Steel Drum	34
Bedford	ESA Labs, Inc.	0	0	0	0	0	SS: Gas chromatography				
Bedford	Millipore Corporation	0	0	0	0	0	R: Protein labeling	Storage for decay, return to manufacturer	45.5		
Bedford	National Environmental Testing, Atlantic, Inc.	0	0	0	0	0	SS: Gas chromatography				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Bedford	Spire Corp.	0	0	0	0	0	SS: Wear monitoring				
Billerica	Aeonic Systems	0	0	0	0	0	SS: Weight measurement				
Billerica	Cambridge Medical Tech. Corp.	0	0	0	0	0	O: License terminated				
Billerica	C. R. Bard Inc., Bard Vascular Systems Division	0	0	0	0	0	O: License terminated				
Billerica	Du Pont Merk Pharmaceutical	314.3	0	0	314.3	86.00906	P: Radio-pharmaceuticals	Compaction, storage for decay	0	Type 7A Container, 55 Gallon Steel Drum	8
Billerica	E.I. Du Pont De Nemours & Co.	132.5	0	0	132.5	23.9146	P: Radio-pharmaceuticals	Compaction, storage for decay	4157	30, 55 & 85, Gallon Steel Drum & 7A Container, Poly HIC,	27
Billerica	E.I. Du Pont De Nemours & Co.	1963.5	92.5	15	2071	1758.54	P: Radio-pharmaceuticals		875	55 Gallon Steel Drum	
Billerica	Inframetrics, Inc.	0	0	0	0	0	SS: Chemical agent detector				
Billerica	MIE, Inc. No response to survey										
Burlington	Amersham Corporation	302.6	0	0	302.6	22.2366	P: radiographic sealed sources	Compaction, storage for decay	277.5	55 Gallon Drum	6
Burlington	Calibration Technology, Inc.	0	0	0	0	0	SS: Calibration sources				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Burlington	Lahey Clinic Medical Center	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	4.8		
Burlington	Millipore Corporation	0	0	0	0	0	R: Biochemistry, protein, & DNA studies	Storage for decay	16.1		
Burlington	M/A-Com Inc., Radar Products Operation	32.08	0	0	32.08	12.0087	P: Microwave receiver protector tubes		8	30 Gallon Steel Drum	3
Burlington	Raytheon Service	0	0	0	0	0	SS: Calibration sources				
Burlington	Scinticor, Inc.	0	0	0	0	0	SS: Calibration sources				
Burlington	Solid State Testing, Inc.	0	0	0	0	0	SS: Leak testing on semiconductors				
Burlington	Visidyne, Inc.	0	0	0	0	0	SS: Calibration sources				
Cambridge	Advanced Magnetics Inc.	381	0	0	381	0.30068	P/R: R & D of pharmaceuticals	Storage for decay, incineration, absorption	7.5	30 & 55 Gallon Drum	12
Cambridge	Alkermes Inc.	67.5	0	0	67.5	0.0127	R: Biological Assays, pharmokinetics in rodents, in-vitro assays in cell cultures	Incineration, sewerage system disposal	0	30 Gallon Drum	2
Cambridge	American Bio-Technologies Inc.	0	0	0	0	0	R: Biotech. research	Storage for decay	5		
Cambridge	American Science & Engineering, Inc.	0	0	0	0	0	SS: Calibration sources				
Cambridge	Applied bioTechnology	15	0	0	15	0.07	R: Biotechnology research	Storage for decay	37.5	55 Gallon Steel Drum	3

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Cambridge	Arthur D. Little Inc.	15	0	0	15	0.017	R: Biochemical experiments		0	55 Gallon Steel Drum	2
Cambridge	BASF Bioresearch Corp.	202.13	0	0	202.13	0.2851	R: Cancer research	Storage for decay	0	Type A 55 Gal Steel Drum	7
Cambridge	Baxter Diagnostics No response to survey										
Cambridge	Biogen Inc.	62.5	0	0	62.5	0.155	R: Biotechnology research and development	Compaction, sorting\ segregation, storage for decay	46	55 Gallon Steel Drum	2
Cambridge	Bioran Medical Laboratory	0	0	0	0	0	S: Medical laboratory testing	None	0		
Cambridge	BioSurface Technology	0	0	0	0	0	R: Biological research	Storage for decay.	8		
Cambridge	Biotechnica Diagnostics, Inc.	0	0	0	0	0	O: License terminated	Storage for decay	0		
Cambridge	Cambridge Hospital	0	0	0	0	0	S: Nuclear medicine				
Cambridge	Cambridge Neuroscience Research	106	0	0	106	0.016577	R: Biological research	Compaction, Incineration, storage for decay	26.5	55 Gallon Steel Drum, 30 Gallon Steel Drum	12
Cambridge	Camp Dresser & McKee	0	0	0	0	0	SS: Analysis of environmental samples				
Cambridge	Charles Stark Draper Laboratory	0	0	0	0	0	R: Radiation hardening testing of electronics	Storage for decay	0		
Cambridge	CytoMed Inc.	0	0	0	0	0	R: DNA labelling		11.51		

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Cambridge	Enzytech, Inc.	52.5	0	0	52.5	0.00041	R: Pharmokinetic studies	Storage for decay	15	55 Gallon Steel Drum	5
Cambridge	ERCO/Enseco	0	0	0	0	0	SS: Electron capture detectors				
Cambridge	Genetics Institute	495	0	0	495	1.463	R: Biological research	Compaction, storage for decay	60	55 Gallon Steel Drum	12
Cambridge	Genzyme Corp.	60	0	0	60	1.2613	R: R & D, DNA & genetic disease testing	Storage for decay	16	55 Gallon Steel Drum	3
Cambridge	Haley & Aldrich, Inc.	0	0	0	0	0	SS: Moisture gauge				
Cambridge	ImmuLogic Pharmaceutical Corporation	34.5	0	0	34.5	0.009146	R: Biomedical research	Incineration, storage for decay	79.5	55 & 30 Gallon Steel Drum	10
Cambridge	ImmunoGen Inc.	4.5	0	0	4.5	0.000103	R: Biological and biochemical research	Storage for decay	0	30 Gallon Steel Drum	2
Cambridge	Imreg Inc.	15	0	0	15	0.01685	O: License terminated	Sorting/ segregation	0	55 Gallon Steel Drum	1
Cambridge	International Biotechnology Labs.	0	0	0	0	0	R: R & D, DNA sequencing, cell line mycoplasma testing, southern analysis	Storage for decay	9.3		
Cambridge	Manlabs, Inc.	0	0	0	0	0	S: Testing of depleted uranium samples				
Cambridge	Matritech Inc.	0	0	0	0	0	R: R & D to develop cancer diagnostic assays	Storage for decay	0		
Cambridge	Metpath Labs Inc.	24	0	0	24	0.00162	C: Diagnostic nuclear medicine	Return to supplier	0		1

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Cambridge	MA Institute of Technology	570	0	0	570	25.92107	S/R: Teaching and biomedical, chemistry, physics, nuclear reactor experiments	Compaction, storage for decay	288.7	30 Gallon Steel Drum	8
Cambridge	Mount Auburn Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Return to supplier	0		
Cambridge	Omnigene Inc.	37.5	0	0	37.5	0.005	R: Biochemical research	Incineration, storage for decay	7.5	55 Gallon Steel Drum	2
Cambridge	Organogenesis Inc.	56.51	0	0	56.51	0.013131	R: Protein labelling	Compaction, adsorption	0	30 & 55 Gallon Steel Drum	4
Cambridge	PharmaMar USA, Inc.	0	0	0	0	0	R: Biological experiments				
Cambridge	Polaroid Corporation	0	0	0	0	0	SS: Thickness measurements				
Cambridge	Procept Inc.	19.5	0	0	19.5	0.000036	R: DNA and protein labelling	Storage for decay	34.5	30 & 55 Gallon Steel Drum	2
Cambridge	Protein Engineering Corporation	0	0	0	0	0	R: Recombination and DNA research	Storage for decay	0		
Cambridge	Repligen Inc.	114.58	0	0	114.58	0.229146	R: Biotechnology R & D	Incineration, storage for decay	0	30 & 55 Gallon Steel Drum	7
Cambridge	Sancta Maria Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Cambridge	SEA Consultants	0	0	0	0	0	O: License terminated				
Cambridge	Somatix Corp.	0	0	0	0	0	O: License terminated				

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Cambridge	T Cell Sciences	6.93	0	0	6.93	0.10635	R: R & D of pharmaceutical and diagnostic reagents	Compaction, incineration, storage for decay	0	30 & 55 Gallon Steel Drum	3
Cambridge	Transkaryotic Therapies Inc.	45	0	0	45	0.0001	C: Molecular biological probes and radioimmunoassays	Storage for decay	22.5	55 Gallon Steel Drum	1
Cambridge	TRW Fasteners Div.	0	0	0	0	0	SS: Analytical measurements				
Cambridge	U.S. DOT, Volpe Transportation Ctr.	0	0	0	0	0	SS: Gas chromatography				
Cambridge	Vertex Pharmaceutical	0	0	0	0	0	R: R & D of human pharmaceutical	Storage for decay	37.5	55 Gallon Drum	
Cambridge	Warner-Lambert Co.	0	0	0	0	0	O: License terminated				
Cambridge	Whitehead Inst. for Biomed. Research	142.5	0	0	142.5	0.252788	R: Biomedical research	Compaction & storage for decay	0	55 & 30 Gallon Steel Drum	3
Chestnut Hill	Boston College	35.3	0	0	35.3	0.07418	S/R: Teaching and research	Storage for decay	0		4
Concord	Emerson Hospital	0	0	0	0	0	C: Diagnostic services	Storage for decay	0		
Concord	Oxford Analytical	0	0	0	0	0	SS: XRF analyzers				
Concord	Nuclear Metals Inc.	10502.48	0	0	10502.48	19.273	P: Manufacture of armor piercing bullets for the A-10 ground support aircraft		0	Steel Box, 30/35 cu. ft. bags, 85 & 89 Gallon Steel Drum, 85/55 Drums, "B-25" Steel Box/55 Drum	23

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Dracut	United Circuits, Inc.	0	0	0	0	0	SS: Thickness measurement				
Everett	M&S Metals Co.	0	0	0	0	0	SS: X-Ray Analysers				
Framingham	Avery-Dennison	0	0	0	0	0	SS: Thickness measurement	SS: Return to supplier			1
Framingham	Dositec, Inc.	0	0	0	0	0	SS: Calibration sources				
Framingham	Framingham Union Hospital	0	0	0	0	0	S: Nuclear Medicine				
Framingham	Gene-Trak Systems, Corp.	7.5	0	0	7.5	0.0202	R: R & D of DNA diagnostic products for the clinical market	Compaction, incineration	90	55 Gallon Steel Drum	2
Framingham	MA Emergency Management Agency	0	0	0	0	0	SS: Training demonstrations and instrument calibration				
Framingham	Perini Corporation No response to survey										
Holliston	Axton-Cross Co.	0	0	0	0	0	O: License terminated				
Hopkinton	Biomeasure Inc.	15	0	0	15	0.241111	R: Pharmaceutical research	Incineration, Storage for decay	0	55 Gallon Steel Drum & 5 Gallon Plastic Drum	4
Hopkinton	Creative Biomolecules Inc.	42.5	0	0	42.5	0.047	R: Biotech research activities	Compaction, storage for decay	23.5	55 Gallon Steel Drum	2
Hopkinton	Liberty Mutual Insurance Co., Research Center	0	0	0	0	0	SS: Calibration sources, gas chromatography				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Hopkinton	Seragen Inc.	240	0	0	240	0.10393	R: Biological research	Compaction	52.5	55 Gallon Steel Drum	9
Hudson	Digital Equipment, Corp.	0	0	0	0	0	SS: Gas chromatography				
Lexington	Instrumentation Laboratories	0	0	0	0	0	O: License terminated	Incineration		55 Gallon Steel Drum	1
Lexington	Interneuron Pharmaceutical Inc.	8.02	0	0	8.02	0.003601	R: Drug development programs	Incineration, storage for decay	0	30 Gallon Steel Drum	1
Lexington	Kendall Co.	0	0	0	0	0	SS: Gas chromatography				
Lexington	Loral Infrared & Imaging Systems	0	0	0	0	0	SS: Tritium light sources				
Lexington	Raytheon Co.	0	0	0	0	0	O: License terminated				
Lexington	Repligen Sandoz Research Corp.	0	0	0	0	0	R: General research purposes	Storage for decay	0		
Lexington	U.S. Environmental Protection Agency	0	0	0	0	0	SS: Gas chromatography & X-ray spectrum meters				
Lexington	W.R. Grace & Co.	0	0	0	0	0	R: Biomedical experiments	Storage for decay	0		
Littleton	Littleton Light & Water Departments	0	0	0	0	0	SS: Gas chromatography				
Lowell	AFT/Multi-Core, Inc., Division of Datasec	0	0	0	0	0	SS: X-ray inspection device				
Lowell	Raytheon Co.	0	0	0	0	0	O: No material on-site				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Lowell	Saint John's Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Lowell	Saint Joseph's Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Lowell	Shawprint No reponse to survey						O: Registration termination in progress				
Lowell	Textron Specialty Materials	0	0	0	0	0	SS: Unknown				
Lowell	Univ. of MA, Lowell	45	0	0	45	0.026	R/S: Research and teaching	Compaction, storage for decay	5	55 Gallon Steel Drum	2
Lowell	Lowell General Hospital	0	0	0	0	0	C: Diagnostic and therapeutic nuclear medicine	Storage for decay	0		
Malden	Charm Sciences Inc.	5	0	0	5	0.039	P: Invitro diagnostic test kits		0.1	55 Gallon Steel Drum	4
Malden	Enzyme Center	5.5	0	0	5.5	0.034	P: Invitro diagnostic kit	Compaction, storage for decay	15	55 Gallon Steel Drum	1
Malden	Malden Hospital	0	0	0	0	0	C: Diagnostic and therapeutic nuclear medicine	Storage for decay	0		
Malden	Packard Paper Box, Company	0	0	0	0	0	O: Registration terminated				
Marlboro	Contraves USA, Boston Division	1	0	0	1	0.0025	P: Components for the M1A1 Tank		0.05	Strong Tight	4

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Marlboro	DesignPak	0	0	0	0	0	SS: Sealed sources				
Marlborough	Marlborough Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Marlborough	Sepracor, Inc	0	0	0	0	0	O: License terminated				
Maynard	Advacare Diagnostics, Inc.	0	0	0	0	0	C: Diagnostic nuclear medicine				
Medford	Lawrence Memorial Hosp.	0	0	0	0	0	C: Clinical nuclear medicine	Storage for decay	0		
Medford	Neil A. Gaeta, CHP No response to survey										
Medford	Tufts University	37.5	0	0	37.5	0.168	R: Labels in biomedical and chemical experiments	Compaction, storage for decay	0		1
Melrose	Melrose-Wakefield Hospital	0	0	0	0	0	C: Diagnostic and therapeutic nuclear medicine	Storage for decay	0		
Natick	Conam Inspection	0	0	0	0	0	SS: Industrial radiography				
Natick	EG&G Berthold, Inc.	35	0	0	35	0.01215	O: License terminated		0	55 & 30 Gallon Steel Drum	1
Natick	Enprotech Corp.	0	0	0	0	0	O: License terminated				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Natick	Imaging Associates Inc.	0	0	0	0	0	C: Nuclear medicine: Bone and thyroid scanning	Storage for decay	0		
Natick	Leonard Morse Hospital	0	0	0	0	0	C: Nuclear medicine imaging	Storage for decay	0		
Natick	Research Biochemicals Inc.						O: License terminated				
Natick	U.S. Army, Natick R&D Center	0	0	0	0	0	R: Research and development	Storage for decay	6		
Newton	Biotechnology Development Corp.	4.01	0	0	4.01	0.000012	O: License terminated	None	0	30 Gallon DOT 17H	1
Newton	GZA GeoEnvironmental	0	0	0	0	0	SS: Nuclear Density Gauges				
Newton	HNU Systems, Inc.	0	0	0	0	0	SS: Gas Chromatography				
Newton	Hygeia Sciences	0	0	0	0	0	R: Research of development of filyer devices				
Newton	Nuclear Medicine Associates	0	0	0	0	0	C: Nuclear medicine				
Newton	Radon Testing Laboratory of New England	0	0	0	0	0	O: Registration terminated				
Newton Highlands	Trow Protze Consulting Engnrs.	0	0	0	0	0	SS: Sealed sources within soil analysis instruments				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Newton Lower Falls	Newton-Wellesley Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Newton Upper Falls	David Gordon Associates	0	0	0	0	0	SS: Gas Chromatography		0		
Somerville	Somerville Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Somerville	Vicam	8	0	0	8	0.41	R: radioimmunoassay in food analysis	Storage for decay	2	30 Gallon Steel Drum	1
Stoneham	C.H.E.M. Shared Services	0	0	0	0	0	SS: Depleted uranium used as shielding				
Stoneham	U T S of Mass, Inc	0	0	0	0	0	SS: Nuclear density gauge				
Stoneham	New England Memorial Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Stow	ET&L Construction Corp.	0	0	0	0	0	SS: Nuclear density gauge				
Sudbury	Medical & Scientific Enterprises	0	0	0	0	0	SS: Calibration sources				
Sudbury	Raytheon Company	4.01	0	0	4.01	0.02917	R: Electronics research and development	Return to supplier	0.5	30 Gallon Steel Drum	1
Tewksbury	Expert Image Systems, Inc.	0	0	0	0	0	O: License termination in progress				
Waltham	Betagen Corp.	0	0	0	0	0	P: Laboratory Instrumentation	Storage for decay	0.39		

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Waltham	Brandeis University	37.5	0	0	37.5	3.782	R: Basic biomedical, chemical, and physical research	Incineration, storage for decay	45	55 Gallon Steel Drum	4
Waltham	Cabot Corporation	0	0	0	0	0	O: License terminated				
Waltham	Collaborative Research Inc.	4.5	0	0	4.5	0.0515	R: Molecular biomedical research	Storage for decay	0	Vendor Choice	4
Waltham	Digital Scintigraphics	0	0	0	0	0	SS: Calibration sources		0		
Waltham	Eunice Kennedy Shriver Center	1.8	0	0	1.8	0.002	R: Biomedical research & clinicals assays	Compaction, Incineration	0	55 Gallon Steel Drum	2
Waltham	Foster-Miller, Inc.	0	0	0	0	0	SS: Density Gauge				
Waltham	GTE Labs Inc.	0	0	0	0	0	SS: Industrial radiography				
Waltham	MA MDC Field Laboratory	0	0	0	0	0	O:License termination in progress				
Waltham	Panametrics	97.6	0	0	97.6	1.05216	R: R & D on radioisotope uses and instrumentation	Macroencapsulation	0	No Info Given	2
Waltham	Raytheon Company	0	0	0	0	0	P: Electron tube cathodes		75		
Waltham	Raytheon Company	0	0	0	0	0	SS: Instruments				
Waltham	SmithKline Beecham Clinical Lab.	240	0	0	240	0.014	C: In-vitro diagnostic testing		0	55 Gallon Steel Drum	3
Waltham	Teledyne Engineering Srvcs	0	0	0	0	0	SS: Non-destructive testing of metals				
Waltham	TGM Detectors Inc.	0	0	0	0	0	SS: Calibration sources				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Waltham	Thermo Electron Technologies Corp.	0	0	0	0	0	SS: Electron beam welding				
Waltham	TMA Skinner & Sherman Laboratories	0	0	0	0	0	S: Analysis of soil samples				
Waltham	U.S. Army Corps of Engineers No response to survey										
Waltham	Waltham/Weston Hospital	0	0	0	0	0	C: Clinical nuclear medicine	Return to supplier	4		
Watertown	Doble Engineering, Co.	0	0	0	0	0	SS: Gas Chromatography				
Watertown	Radiation Monitoring Device, Inc.	0	0	0	0	0	S: Testing response of detectors and instruments	Storage for decay	75		
Watertown	U.S. Army Materials Technology Lab.	0	0	0	0	0	R: Materials research		652.5		
Wayland	Raytheon Company	0	0	0	0	0	O: License terminated				
West Newton	MA Department of Labor & Industries	0	0	0	0	0	O: License terminated				
Westford	Courier Westford	0	0	0	0	0	SS: Storage of unused material				
Wilmington	Charles River Laboratories	0	0	0	0	0	R: Genetic research	Storage for decay	0		
Wilmington	Ion Track Instruments	0	0	0	0	0	SS: Gas chromatography				

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		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Wilmington	New England Pathology Services	0	0	0	0	0	S: RIA testing	Storage for decay	0		
Wilmington	Textron Defense Systems	0	0	0	0	0	SS: Sealed sources within instruments				
Winchester	GEI Consultants, Inc.	0	0	0	0	0	SS: Nuclear density gauges				
Winchester	U.S. Health & Human Services Department, FDA	7.5	0	0	7.5	0.6024	R: Research and development	Storage for decay	0	55 Gallon Steel Drum	1
Winchester	Winchester Hospital	0	0	0	0	0	C: Clinical nuclear medicine	Storage for decay	0		
Woburn	Analytical Answers	0	0	0	0	0	SS: X-Ray fluorescent analyzer				
Woburn	Biotechnology Management Association	0	0	0	0	0	S: Product testing of biotechnology and pharmaceutical products	Storage for decay	0		
Woburn	BIOTEK, Inc.	7.5	0	0	7.5	0.00301	R: In-vitro experiments	None	10	55 Gallon Steel Drum	2
Woburn	Crystal Diagnostics, Inc.						O: License termination in progress				
Woburn	GENTEST, Corp.	0	0	0	0	0	R: Metabolism and molecular biology studies	Storage for Decay	16		
Woburn	Micro-Dynamics Inc.	16.04	0	0	16.04	0	P: Manufacture of transmit\receive components used in microwave radar system applications		0	30 Gallon Steel Drum	2

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume	Total Activity					
Woburn	Syncor International Corp.	0	0	0	0	0	P: Manufacture of unit doses for nuclear medicine departments	Compaction, storage for decay	466		20
Woburn	Toxikon Corporation	0	0	0	0	0	C: Toxicological testing				
Norfolk County											
Avon	T.L. Edwards, Inc. No response to survey										
Braintree	American Engineering & Testing	0	0	0	0	0	SS: Moisture and density analysis of soil and asphalt				
Braintree	Clean Harbors Analytical Services, Inc.	0	0	0	0	0	P: Laboratory analysis				
Braintree	Wollaston Alloys, Inc.	0	0	0	0	0	SS: X-Ray analyzer				
Brookline	Boston Fertility Laboratory Inc.	0	0	0	0	0	C: Diagnostic testing		0		
Brookline	Boston Imaging Group P.C.	0	0	0	0	0	C: Diagnostic testing				
Brookline	Dr. Elias Charles Dow	0	0	0	0	0	C: Thyroid treatment				
Brookline	Life Signs/Group, Inc., Boston Cardiovascular Health Center	0	0	0	0	0	S: Nuclear medicine				
Canton	CWB Associates, Inc.	0	0	0	0	0	O: License terminated				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume	Total Activity					
Canton	Plymouth Rubber Co.	0	0	0	0	0	SS: Nuclear density gauge				
Canton	Tamfelt Inc.	0	0	0	0	0	SS: Fabric weight measurements				
East Walpole	Ciba Corning Diagnostics Corp.	1223.9	0	0	1223.9	4.99852	P: Manufacture, R&D of Immunodiagnostic reagent kits	Incineration, storage for decay	15	30 & 55 Gallon Steel Drum	9
Medfield	Ciba Corning Diagnostics Corp.	0	0	0	0	0	R:Medical diagnostic research	Storage for decay	0		
Medfield	Strichman Medical Equipment Inc.	1	0	0	1	0.000001	P: Used in calibration testing during manufacturing operations	Storage for decay	0		1
Millis	GAF Building Materials Corp.	0	0	0	0	0	SS: Nuclear density gauge				
Milton	Milton Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Needham	Civiltest Labs., Inc.	0	0	0	0	0	SS: Nuclear density gauge				
Needham	Glover Memorial Hospital	0	0	0	0	0	C: Medical imaging and diagnostics	Storage for decay	0		1
Needham Heights	Abbott Biotech Inc.	60.4	0	0	60.4	0.041096	R: Biomedical Research: radiolabeling of cells, DNA sequencing analysis, radioimmunoassay	Storage for decay	0	55 & 30 Gal Steel Drum, 30 Gallon Steel Drum	3
Needham Heights	GTE Government Sys Corp	0	0	0	0	0	SS: sealed sources				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Norfolk	Southwood Community Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Norwood	Factory Mutual Research Corp.	0	0	0	0	0	SS: Industrial Radiography				
Norwood	Norwood Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Quincy	Eastern Nazarene College No response to survey										
Quincy	Herbert V. Shuster	0	0	0	0	0	O: License terminated				
Quincy	Procter & Gamble Mfg. Co.	0	0	0	0	0	SS: Sealed sources in various instruments				
Quincy	Quincy Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	22.5		
Randolph	Ares Advanced Technology	0	0	0	0	0	R: Radioimmunoassay, metabolic labelling	Storage for decay	0		
Randolph	Serono Laboratories	120	0	0	120	0.011	C: Quality control testing	Compaction	48	30 Gallon Steel Drum	1
South Weymouth	South Shore Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	0		
Stoughton	Biomedical Technologies Inc.	0	0	0	0	0	P: Labelling compounds	Storage for decay	0		
Stoughton	Goddard Memorial Hospital	0	0	0	0	0	C: Diagnostic procedures				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Stoughton	R. Zoppo Co, Inc.	0	0	0	0	0	O:License terminated				
Wellesley	MA Department of Public Works	0	0	0	0	0	SS: Nuclear Density Gauge				
Wellesley	Wellesley College	0	0	0	0	0	S\H: Teaching and research				
Westwood	Damon Clinical Lab.	0	0	0	0	0	R: In-vitro testing	Storage for decay	0		
Westwood	PB Diagnostic Systems Inc.	45	0	0	45	0.000001	R: R & D of medical diagnostic procedures	Storage for decay	34.5	55 Gallon Steel Drum	3
Weymouth	Gale Associates, Inc.	0	0	0	0	0	SS: Nuclear density gauge				
Wrentham	Bella Construction Corp.	0	0	0	0	0	SS: Moisture density gauge				
Plymouth County											
Bridgewater	ABC Testing, Inc.	0	0	0	0	0	SS: Radiography				
Bridgewater	Bridgewater State College	0	0	0	0	0	R/S: Teaching and research	Storage for decay	7		
Brockton	Advacare Diagnostics, Inc.	0	0	0	0	0	C: Medical Diagnostic outpatient testing	Storage for decay	0		
Brockton	Brockton Hospital	0	0	0	0	0	C: Diagnostics, radiation therapy	Storage for decay	0		
Brockton	Cardinal Cushing General Hospital	0	0	0	0	0	C: Diagnostics, and thyroid therapy	Storage for decay	0		
Duxbury	Battelle Ocean Sciences	0	0	0	0	0	SS: Gas chromatography				

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City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Hingham	Electro Signal Lab No response to survey										
Hingham	High Vacuum Equipment	0	0	0	0	0	O: Registration terminated				
Lakeville	Ocean Spray Cranberries	0	0	0	0	0	P: Cranberry products	Return to supplier			1
Marion	Endeco, Inc.	0	0	0	0	0	SS: Used in manufacture of instruments				
Middleboro	St. Luke's Hospital of Middleboro	0	0	0	0	0	C: Diagnostic procedures				
Plymouth	Bartlett Nuclear Inc.	0	0	0	0	0	S: Decontamination & laundry services to the nuclear industry	None	7000		
Plymouth	Boston Edison	11880.9	202.1	264.8	12347.8	706.4445	P: Electric power generation	Compaction, incineration	55.08	Steel Liner, 10/142 Poly HIC, 14/210 Poly HIC, & 14/215 Poly HIC	48
Plymouth	Jordan Hospital	0	0	0	0	0	C: Clinical nuclear medicine	Storage for decay	0		
Rochester	SEMASS Partnership	0	0	0	0	0	SS: sealed sources				
Rockland	Baker Testing Services	0	0	0	0	0	SS: Industrial radiography				
Rockland	Biomerieux Vitek Inc.	405.5	0	0	405.5	0.913	P: In-vitro diagnostic kits	None	0	55 Gallon Steel Drum	6

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Rockland	Briggs Associates, Inc.	0	0	0	0	0	SS: Industrial radiography & lead paint inspection				
Rockland	Nuclear Instrument	0	0	0	0	0	SS: Calibration sources				
Wareham	Springborn Laboratories Inc.	247.5	0	0	247.5	0.107576	R: Environmental fate and aquatic toxicology studies	Compaction	0	55 Gallon Steel Drum	3
Wareham	Tobey Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	22.5		
Suffolk County											
Boston	Bechtel/Parsons Brinckerhoff	0	0	0	0	0	SS: Density & moisture analysis of soil & asphalt				
Boston	Beth Israel Hospital	14.7	0	0	14.7	0.00996	C: Nuclear medicine, radiation therapy, radioimmunoassays	Storage for decay	0	Type A 55 Gal Steel Drum	1
Boston	Bolton & Galanek	0	0	0	0	0	SS: Calibration sources				
Boston	Boston Biomedical Research Institute	0	0	0	0	0	R: Biological research	None	0		
Boston	Boston City Hospital	193.8	0	0	193.8	0.02842	C\R: Nuclear medicine, biomedical research, clinical procedures	Compaction, Storage for decay	0	55 Gallon Steel Drum	11
Boston	Boston University	7.76	0	0	7.76	0.010181	R: Biomedical research	Compaction, Incineration, storage for decay	22.5	50 Gallon 17H, 30 Gallon Drum	5

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Boston	Boston University Medical Center	488.17	0	0	488.17	48.5301	C/R: Medical research, clinical procedures	Storage for decay	0		13
Boston	Brigham & Women's Hospital	51.7	0	0	51.7	0.011756	C/R: Nuclear medicine, biomedical research, clinical procedures	Storage for decay, incineration	0	55 Gallon Steel Drum	17
Boston	Bunker Hill Community College	0	0	0	0	0	R: Teaching and research				
Boston	Carney Hospital	0	0	0	0	0	C: Clinical nuclear medicine	Storage for decay	0		
Boston	Center For Blood Research Inc.	0	0	0	0	0	R: Laboratory tracer studies	Storage for decay	22.5		
Boston	Children's Hospital	61.7	0	0	61.7	0.045116	C/R: Medical research and diagnostics	Storage for decay	0	55 Gallon Steel Drum	8
Boston	Dana-Farber Cancer Institute	21.9	0	0	21.9	0.06511	C/R: Biomedical and cancer research, diagnosis and therapy	Incineration, storage for decay, compaction	0	55 Gallon Steel Drum	17
Boston	David C. Sprogis	0	0	0	0	0	O: License terminated				
Boston	Dr. Carl E. Cassidy	0	0	0	0	0	C: Thyroid therapy				
Boston	E.I. Du Pont De Nemours & Co.	2925.8	90	0	3015.8	29611.42	P: Manufacturer of radiopharmaceutical	Compaction, storage for decay	0	55 & 30 Gallon Steel Drums, 400 Liter HIC, & Steel Cask	3
Boston	Faulkner Hospital	0		0	0	0	C: Medical imaging and diagnostics	Storage for decay	0		
Boston	Forsyth Dental Center	0	0	0	0	0	R: Biomedical research	Incineration, Storage for decay	7.5		2

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Boston	Harvard University	79.5	0	0	79.5	0.089526	R/S: Medical research and development, student teaching	Incineration, Compaction	0	55 Gallon Steel Drum	6
Boston	Institute of Molecular Biology	45	0	0	45	0.0242	R: Cell culture and process purification labeling		0	55 Gallon Steel Drum	5
Boston	Joslin Diabetes Center	12.1	0	0	12.1	0.004	C/R: Biomedical research and clinical assays	Storage for decay	4.8	55 Gallon Steel Drum	2
Boston	Kupferman & Weber	0	0	0	0	0	O: License terminated				
Boston	MA Department of Public Health No response to survey										
Boston	Massachusetts Eye & Ear Infirmary	0.5	0	0	0.5	0.000001	R: Medical research for investigation of opthamalogy and otolaryngology diseases	Compaction, storage for decay	0	55 Gallon Steel Drum	1
Boston	Massachusetts Port Authority	0	0	0	0	0	SS: Nuclear density gauge				
Boston	Mass. College Of Pharmacy/AHS	0	0	0	0	0	S/R: Teaching and research in radiopharmaceuticals	Storage for decay	0		
Boston	MSPCA Angell Memorial Animal Hospital	0	0	0	0	0	S: Veterinarian hospital	Storage for decay			
Boston	Museum of Fine Arts	0	0	0	0	0	SS: Analysis of papers and documents				

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants (continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Boston	New England Aquarium	0	0	0	0	0	R: Basic and applied research of metabolic pathways in marine organisms		1.1		
Boston	New England Baptist Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Boston	New England Deaconess Hospital	320.2	1.36	0	321.56	1.459712	C/R: Nuclear medicine and research		0	85, 55 & 30 Gallon Steel Drum	18
Boston	New England Medical Center	198.8	0	0	198.8	16.21045	C/R: Nuclear medicine and biological research	Storage for decay	0	55 Gallon Steel Drum	9
Boston	P.X. Engineering Company	0	0	0	0	0	SS: Sealed sources				
Boston	Simmons College	0	0	0	0	0	R: Biological research	Storage for decay	7.5		
Boston	Spaulding Rehabilitation Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	13482		
Boston	Stone & Webster Engineering Corp.	0	0	0	0	0	SS: Radiography				
Boston	St. Elizabeth's Hospital No response to survey										
Boston	Suffolk University	0	0	0	0	0	SS: Teaching and research				
Boston	The Gillette Company Toiletries Tech Lab	0	0	0	0	0	R: R & D of toiletry products		1.2		

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Boston	U.S. DOT, U.S. Coast Guard	0	0	0	0	0	SS: Contraband detector				
Boston	Univ. of MA, Boston	30	0	0	30	0.00099	R/S: Research and teaching	Storage for decay	0	55 Gallon Steel Drum	1
Boston	U.S.D.A., Human Nutrition Research Center	47.9	0	0	47.9	0.067241	R: Biomedical research	Compaction, incineration	0	55 Gallon Steel Drum	8
Boston	Massachusetts General Hospital	37.3	0	0	37.3	0.005061	C: Diagnostic nuclear medicine and research	Compaction, storage for decay	288.72	55 Gallon Steel Drum	5
Boston	Nissin Molecular Biology Institute	9	0	0	9	0.0041	R: DNA sequencing	Compaction, incineration, storage for decay	0	Steel Drum	3
Boston	Northeastern University	24.108	0	0	24.108	1.396	R/S: Research and teaching	Compaction, incineration, storage for decay	0	30 Gallon Steel Drum	
Boston	The Eye Research Institute of Retina Foundation	0.8	0	0	0.8	0.00001	R: Biomedical research	Incineration, storage for decay	0	55 Gallon Steel Drum	1
Boston	Tufts University School of Medicine	231.25	0	0	231.25	0.38777	R: Biomedical research	Compaction, incineration	0	55 Gallon Steel Drum	12
Boston	V.A. Medical Center	7.6	0	0	7.6	0.00093	C: Clinical nuclear medicine and laboratory studies	Compaction, incineration, & storage for decay	22.5	55 Gallon Steel Drum	1

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Dedham	American Red Cross Blood Services	0	0	0	0	0	C: Analysis to determine matching for bone marrow transplanting	Storage for decay	0.15		
Dorchester	MA Bay Transportation Authority	0	0	0	0	0	SS: Nuclear density gauge				
Dorchester	St. Margaret's Hospital for Women	0	0	0	0	0	C: Diagnostic procedures				
Everett	Whidden Memorial Hospital	0	0	0	0	0	C: Clinical nuclear medicine	Storage for decay	0		
West Roxbury	V.A. Medical Center	0	0	0	0	0	C: Clinical nuclear medicine, and biomedical research	Compaction, incineration, storage for decay	0		3
Winthrop	Winthrop Hospital	0	0	0	0	0	C: Clinical nuclear medicine	Storage for decay	32		
Worcester County											
Auburn	Cullinan Engineering Co., Inc.	0	0	0	0	0	SS: Nuclear density gauge				
Barre	Northeast Consultants, Inc.	0	0	0	0	0	SS: Nuclear Density Gauge				
Clinton	LFE Corp.	0	0	0	0	0	SS: Industrial radiation gauges				
Fitchburg	Fitchburg State College	0	0	0	0	0	R: Research and positron annihilation spectroscopy		7.5		

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Fitchburg	Burbank Hospital	0	0	0	0	0	C: Diagnostics, radiation therapy for hyperthyroidism	Storage for decay	0		
Fitchburg	Dr. Robert L. McAuley, Pathologist	0	0	0	0	0	O: License terminated				
Gardner	Henry Heywood Memorial Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Holden	The Medical Center of Central MA	0	0	0	0	0	C: Medical diagnostic procedure				
Leominster	Leominster Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay	0		
Milford	Center for Diagnostic Products No response to survey										
Milford	Milford-Whitinsville Regional Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	45.5		
Milford	Millipore Corp.	0	0	0	0	0	O: License termianted				
North Grafton	Wyman-Gordan Company	0	0	0	0	0	SS: Gas chromatography				
Paxton	Anna Maria College	0	0	0	0	0	R: Research and teaching				
Shrewsbury	Biohybrid Technologies	0	0	0	0	0	C: Radioimmunoassay procedures	Storage for decay	0		
Shrewsbury	Digital Equipment Corporation	0	0	0	0	0	SS: Gas chromatography		0		1

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Shrewsbury	Worcester Foundation For Experimental Biology	30	0	0	30	1.32	R: Biomedical teaching and research	Storage for decay	184	55 Gallon Steel Drum	2
Southbridge	Harrington Memorial Hospital No response to survey										
West Boylston	MA Materials Research, Inc.	0	0	0	0	0	SS: Industrial radiography				
Westborough	Alpha Analytical Laboratories, Inc.	0	0	0	0	0	SS: EPA performance evaluation testing				
Westborough	Haller Testing Labs of MA, Inc.	0	0	0	0	0	SS: Measurement of material density				
Worcester	Amira Inc.	0	0	0	0	0	R: DNA synthesis	Storage for decay	0		
Worcester	Cambridge Biotech Corporation	15	0	0	15	0.058664	R: DNA research	Storage for decay	.5	55 & 30 Gallon Steel Drum	2
Worcester	Clark University	0	0	0	0	0	R: Biological and physical research	Storage for decay	0		0
Worcester	College Of The Holy Cross	0	0	0	0	0	R/S: Biological experimentation for teaching and research	Storage for decay	0		
Worcester	Dr. Richard J. Broggi	0	0	0	0	0	O: License terminated				
Worcester	Hybridon, Inc.	0	0	0	0	0	R: Biomedical research	Storage for decay	15		
Worcester	Professional Service Industries, Inc.	0	0	0	0	0	SS: sealed sources				

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Worcester	Saint Vincent Hospital	0	0	0	0	0	C: Diagnostic nuclear medicine	Storage for decay, return to supplier	52.5		
Worcester	Salitsky Alloys, Inc.	0	0	0	0	0	SS: Metal testing				
Worcester	The Medical Center Of Central Massachusetts	0	0	0	0	0	C: Diagnostic nuclear medicine	Return to supplier	17		
Worcester	The Medical Center Of Massachusetts	0	0	0	0	0	C: Diagnostic nuclear medicine and research	Storage for decay, return to supplier	0		
Worcester	TSI Mason Research Institute	48	0	0	48	0.000044	R: Development and performance of RIA procedures	Compaction, incineration, storage for decay	69.6	55 Gallon Steel Drum	3
Worcester	Universal Metal Corporation	0	0	0	0	0	SS: Non-destructive metal				
Worcester	University Of MA Medical Center	7.5	0	0	7.5	2.7	C: Patient diagnosis and treatment	Storage for decay	93.5	55 Gallon Steel Drum	1
Worcester	Wire & Metal Separation Systems, Inc	0	0	0	0	0	SS: Metal analysis				
Worcester	Worcester City Hospital	0	0	0	0	0	O: License terminated				
Worcester	Worcester Department of Public Health	0	0	0	0	0	SS: Gas chromatography				
Worcester	Worcester Polytechnic Institute	0	0	0	0	0	S/R: Teaching and research	Storage for decay	21.0		

Appendix A
Inventory of Massachusetts Radioactive Materials Licensees and Registrants
(continued)

City	Organization	Description of Waste Shipped for Disposal					Product/Service Information (see codes at end of table)	Reported Source/Waste Volume Reduction	Total Waste Stored On-Site	Shipping Containers	Number of Shipments
		Class A	Class B	Class C	Total Volume (cu. ft.)	Total Activity (curies)					
Worcester	Yankee Engineering & Testing Inc.	0	0	0	0	0	SS: Measurement of soil and pavement density.				
Totals		41,780	386	520	42,686	32,530			29,084		

P = Product; S = Service; R = Research; C = Clinical Procedures; and O = Other

The column showing "reported source/waste volume reduction is blank in those areas where the licensee uses only sealed sources. Some generators that shipped for disposal did not report using any volume reduction methods.

"Total Waste Stored On-Site" includes waste in storage for future off-site disposal and does not include waste being treated by storage for decay.

"Number of Shipments" refers to all radioactive waste shipments as reported by the generator and includes shipments to brokers, processors, directly to a disposal site, or waste being returned to a supplier.

Appendix B
1991 Generator Listing by Volume and Actvity
(cubic feet and curies)

Company	Total Volume Disposed	% of Total	Cumulative %	Company	Total Disposed Activity	% of Total	Cumulative %
Boston Edison	12347.8	28.93	28.93	E.I. Du Pont De Nemours (Boston)	29611.4181	91.03	91.026
Nuclear Metals Inc.	10502.48	24.60	53.53	E.I. Du Pont De Nemours & Co. (Billerica)	1758.157	5.40	96.509
Yankee Atomic Electric Co.	5797	13.58	67.11	Boston Edison	706.4444691	2.17	98.681
E.I. Du Pont De Nemours & Co. (Boston)	3015.8	7.07	74.18	Yankee Atomic Electric Co.	89.722	0.28	98.957
E.I. Du Pont De Nemours & Co. (Billerica)	2071	4.85	79.03	Du Pont Merk Pharmaceuticals	86.009059	0.26	99.221
Ciba Corning Diagnostics Corp	1223.9	2.87	81.90	Varian Associates	76.00227	0.23	99.455
MIT	570	1.34	83.23	Boston Univ. Medical Ctr.	48.5301	0.15	99.604
Genetics Institute	495	1.16	84.39	MIT	25.9210711	0.08	99.684
Boston Univ. Medical Center	488.17	1.14	85.53	E.I. Du Pont De Nemours & Co.	23.707822	0.07	99.757
Biomerieux Vitek Inc.	405.5	0.95	86.48	Amersham Corp.	22.2366	0.07	99.825
Advanced Magenetics Inc.	381	0.89	87.38	Nuclear Metals Inc.	19.273	0.06	99.884
New England Deaconess Hospital	321.56	0.75	88.13	New England Medical Center	16021045	0.05	99.934
Du Pont Merk Pharmaceuticals	314.3	0.74	88.87	M/A-Com Inc. Radar Products Operation	12.0087	0.04	99.971
Amersham Corporation	302.6	0.71	89.58	Ciba Corning Clagnostics Corp.	4.99852	0.02	99.986
Springborn Laboratories Inc.	247.5	0.58	90.16	ENRM Veterans Hospital	4.9148	0.01	100.001
Seragen Inc.	240	0.56	90.72	Brandeis Univ.	3.782	0.01	100.013
SmithKline Beecham Clinical Lab.	240	0.56	91.28	Univ. of MA Med. Ctr.	2.7	0.01	100.021
Tufts Univ. School of Medicine	231.25	0.54	91.82	Interstate Nuclear Services	1.63790573	0.00	100.026
Interstate Nuclear Services	207	0.48	92.31	Genetics Institute	1.463	0.00	100.031
BASF	202.13	0.47	92078	New England Deaconess Hospital	1.49712	0.00	100.035
New England Medical Center	198.8	0.47	93.25	CIS-US Inc.	1.4315	0.00	100.040
Boston City Hospital	193.8	0.45	93.70	Northeaster Univ.	1.396	0.00	100.044
Whitehead Institute for Biomedical Research	142.5	0.33	94.03	Worcester Foundation for Experimental Biology	1.32	0.00	100.048
E.I. Du Pont De Nemours & Co. (Billerica)	132.5	0.31	94.34	Genzyme	1.2613	0.00	100.052
Univ. of MA Amherst	120	0.28	94.63	Panametrics	1.05216006	0.00	100.055

Appendix B
1991 Generator Listing by Volume and Actvity
(cubic feet and curies)
(continued)

Company	Total Volume Disposed	% of Total	Cumulative %	Company	Total Disposed Activity	% of Total	Cumulative %
Serono Laboratories	120	0.28	94.91	Biomerleux Vitek Inc.	0.913	0.00	100.061
Repligen Inc.	114.58	0.28	95.18	EG&G Inc.	0.890103	0.00	100.061
Cambridge NeuroScience Research Center	106	0.25	95.42	USHHS/Food & Drug Adm.	0.6024	0.00	100.063
Panametrics	97.6	0.23	95.65	Vicam	0.41	0.00	100.064
Harvard University	79.5	0.19	95.84	Tufts Univ. School of Medicine	0.38777	0.00	100.065
Alkermes Inc.	67.5	0.16	96.00	Advanced Magnetics Inc.	0.30068	0.00	100.066
Biogen Inc.	62.5	0.15	96.14	BASF	0.2581	0.00	100.067
Children's Hospital	61.7	0.14	96.29	Whitehead Institute for Biomedical Research	0.252788	0.00	100.068
Varian Associates	61.3	0.14	96.43	Digital Equipment Corp. (Andover)	0.25009	0.00	100.068
Abbott Biotech Inc.	60.4	0.14	96.57	Biomeasure Inc.	0.2411114	0.00	100.069
Genzyme	60	0.14	96.71	Repligen Inc.	0.229146	0.00	100.070
Organogenesis Inc.	56.51	0.13	96.85	Tufts Univ.	0.168	0.00	100.070
Enzytech	52.5	0.12	96.97	Biogen Inc.	0.155	0.00	100.071
Marine Biological Laboratory	52	0.12	97.09	Univ. of MA Amherst	0.14484	0.00	100.071
Brigham & Women's Hospital	51.7	0.12	97.21	Woods Hole Oceanographic Inst.	0.1165	0.00	100.072
TSI Mason Industries	48	0.11	97.32	Springborn Lab. Inc.	0.107576	0.00	100.072
USDA Human Nutrition Research Center	47.9	0.11	97.44	T Cell Sciences	0.10635	0.00	100.072
Institute of Molecular Biology	45	0.11	97.54	Seragen Inc.	0.10393	0.00	100.073
PB Diagnostic Systems Inc.	45	0.11	97.65	Marine Biological Lab.	0.09	0.00	100.073
ENRM Veterans Hospital	45	0.11	97.75	Harvard University	0.0895261	0.00	100.073
Transkaryotic Therapies Inc.	45	0.11	97.86	Boston College	0.0741801	0.00	100.073
Univ. of MA Lowell	45	0.11	97.96	Applied bioTechnology	0.07	0.00	100.074
Creative Biomolecules Inc.	42.5	0.10	98.06	USDA Human Nutrition Research Ctr.	0.067241	0.00	100.074
Woods Hole Oceanographic Institute	40.1	0.09	98.16	Dana-Farber Cancer Inst.	0.0651097	0.00	100.074
Tufts University	37.5	0.09	98.24	Cambridge Biotech Corp.	0.058664	0.00	100.074
Omnigene Inc.	37.5	0.09	98.33	Collaborative Research Inc.	0.0515	0.00	100.074

Appendix B
1991 Generator Listing by Volume and Actvity
(cubic feet and curies)
(continued)

Company	Total Volume Disposed	% of Total	Cumulative %	Company	Total Disposed Activity	% of Total	Cumulative %
Brandels University	37.5	0.09	98.42	Creative Biomolecules Inc.	0.047	0.00	100.074
Massachusetts General Hospital	37.3	0.09	98.51	Children's Hospital	0.0451164	0.00	100.075
Boston College	35.3	0.08	98.59	Abbott Biotech Inc.	0.04109615	0.00	100.075
EG&G Berthold	35	0.08	98.67	Charm Sclences Inc.	0.039	0.00	100.075
ImmuLogic Pharmaceutical Corp.	34.5	0.08	98375	Enzyme Center	0.034	0.00	100.075
M/A-Com Inc. Radar Products Operation	32.08	0.08	98.83	Raytheon Company	0.02917	0.00	100.075
Worcester Foundation for Experimental Biology	30	0.07	98.90	Boston City Hospital	0.02842	0.00	100.075
Univ. of MA Boston	30	0.07	98.97	Univ. of MA Lowell	0.026	0.00	100.075
Northeastern University	24.108	0.06	99.03	Institute of Molecular Biology	0.0242	0.00	100.075
Metpath Labs Inc.	24	0.06	99.08	Kidde-Fenwal Inc.	0.021	0.00	100.075
Dana-Farber Cancer Institute	21.9	0.05	99.13	Gene-Trak System Corp.	0.0202	0.00	100.075
EG&G Inc.	21.3	0.05	99.18	Smith College	0.019215	0.00	100.075
Mallinckrodt Medical Inc.	20.05	0.05	99.23	Arthur D. Little Inc.	0.017	0.00	100.075
Procept Inc.	19.5	0.05	99.28	Imreg Inc.	0.01685	0.00	100.076
Micro-Dynamics Inc.	16.04	0.04	99.31	Cambridge NeuroScience	0.016577	0.00	100.076
Cellcor Therapies Inc.	16.04	0.04	99.35	Eisai Research Inst.	0.015	0.00	100.076
Arthur D. Little Inc.	15	0.04	99.39	Smithkline Beecham Clinical Lab.	.0140	0.00	100.076
Applied bioTechnology	15	0.04	99.42	Organogenesis Inc.	0.013131	0.00	100.076
Biomeasure Inc.	15	0.04	99.46	Alkermes Inc.	0.0127	0.00	100.076
Imreg Inc.	15	0.04	99.49	EG&G Berthold	0.01215	0.00	100.076
Eisai Research Institute	15	0.04	99.53	Brigham & Women's Hospital	0.0117558	0.00	100.076
Smith College	15	0.04	99.56	Serono Lab.	0.011	0.00	100.076
Cambridge Biotech Corp.	15	0.04	99.60	Boston University	0.010181	0.00	100.076
Beth Israel Hospital	14.7	0.03	99.63	Beth Israel Hospital	0.00996	0.00	100.076
Joslin Diabetes Center	12.1	0.03	99.66	ImmuLogic Pharm. Corp.	0.0091455	0.00	100.076
Nissin Molecular Biology Inst.	9	0.02	99.68	MA General Hospital	0.0050612	0.00	100.076
Interneuron Pharmaceuticals Inc.	8.02	0.02	99.70	Omnigene Inc.	0.005	0.00	100.076

Appendix B
1991 Generator Listing by Volume and Actvity
(cubic feet and curies)
(continued)

Company	Total Volume Disposed	% of Total	Cumulative %	Company	Total Disposed Activity	% of Total	Cumulative %
Spraugue Electric Company	8.02	0.02	99.72	Nissin Molecular Biology Inst.	0.0041	0.00	100.076
Vicam	8	0.02	99.74	Joslin Diabetes Center	0.004	0.00	100.076
Boston University	7.76	0.02	99.76	Interneuron Pharm. Inc.	0.003601	0.00	100.076
V.A. Medical Center (Boston)	7.6	0.02	99.77	BIOTEK, Inc.	0.00301	0.00	100.076
G.E. Aerospace	7.5	0.02	99.79	Contraves U.S.A.	0.0025	0.00	100.076
BIOTEK, Inc.	7.5	0.02	99.81	Eunice Kennedy Shriver Ctr.	0.002	0.00	100.076
Gene-Trak Systems Corp.	7.5	0.02	99.83	Sprague Electric Co.	0.00191	0.00	100.076
USHHS/Food & Drug Adm.	7.5	0.02	99.84	Cellcor Therapies Inc.	0.0014	0.00	100.076
Univ. of MA Medical Center	7.5	0.02	99.86	Univ. of MA Boston	0.00099	0.00	100.076
CIS-US Inc.	7.5	0.02	99.88	V.A. Medical Ctr. (Boston)	0.00093	0.00	100.076
T Cell Sciences	6.93	0.02	99.89	Enzytech	0.0041	0.00	100.076
U.S. Army Natick R & D Ctr.	6	0.01	99.91	Franklin Medical Ctr.	0.000402	0.00	100.076
Enzyme Center	5.5	0.01	99.92	G.E. Aerospace	0.00039829227	0.00	100.076
Charm Sciences Inc.	5	0.01	99.93	Mepath Labs Inc.	0.000162	0.00	100.076
ImmunoGen Inc.	4.5	0.01	99.94	ImmunoGen Inc.	0.000103	0.00	100.076
Collaborative Research Inc.	4.5	0.01	99.95	U.S. Army Natick R&D Ctr.	0.000097	0.00	100.076
Biotechnology Development	4.01	0.01	99.96	Transkaryotic Therapies	0.000081	0.00	100.076
Raytheon Company	4.01	0.01	99.97	TSI Mason Industries	0.000435	0.00	100.076
Digital Equipment Corp. (Andover)	4.01	0.01	99.98	Procept Inc.	0.00003583	0.00	100.076
Franklin Medical Center	2	0.00	99.99	Biotechnology Development Corp.	0.000012	0.00	100.076
Eunice Kennedy Shriver Ctr.	1.8	0.00	99.99	The Eye Research Inst. of Retinal Fndtn.	0.00001	0.00	100.076
Contraves U.S.A.	1	0.00	99.99	MA Eye & Ear Infirmary	1.00000E-06	0.00	100.076
Strichman Medical Equipment Inc.	1	0.00	100.00	Strichman Medical Equip.	1.00000E-06	0.00	100.076
The Eye Research Institute of Retina Foundation	0.8	0.00	100.00	PB Diagnostic System Inc.	1.00000E-06	0.00	100.076
Kidde-Fenwal Inc.	0.67	0.00	100.00	Mallinckrodt Medical Inc.	6.052210E	0.00	100.076
MA Eye & Ear Infirmary	0.5	0.00	100.00	Micro Dynamics Inc.	*	*	*

* No information provided by this generator.

Appendix C
Elements

Element	Symbol	Element	Symbol	Element	Symbol
Actinium	Ac	Francium	Fr	Nobelium	No
Aluminum	Al	Gadolinium	Gd	Osmium	Os
Americium	Am	Gallium	Ga	Oxygen	O
Antimony	Sb	Germanium	Ge	Palladium	Pd
Argon	Ar	Gold	Au	Phosphorus	P
Arsenic	As	Hafnium	Hf	Platinum	Pt
Astatine	At	Helium	He	Plutonium	Pu
Barium	Ba	Holmium	Ho	Polonium	Po
Berkelium	Bk	Hydrogen	H	Potassium	K
Beryllium	Be	Indium	In	Praseodymium	Pr
Bismuth	Bi	Iodine	I	Promethium	Pm
Boron	B	Iridium	Ir	Protactinium	Pa
Bromine	Br	Iron	Fe	Radium	Ra
Cadmium	Cd	Krypton	Kr	Radon	Rn
Calcium	Ca	Lanthium	La	Rhenium	Re
Californium	Cf	Lawrencium	Lr	Rhodium	Rh
Carbon	C	Lead	Pb	Rubidium	Rb
Cerium	Ce	Lithium	Li	Ruthenium	Ru
Cesium	Cs	Lutetium	Lu	Samarium	Sm
Chlorine	Cl	Magnesium	Mg	Scandium	Sc
Chromium	Cr	Manganese	Mn	Selenium	Se
Cobalt	Co	Mendelevium	Md	Silicon	Si
Copper	Cu	Mercury	Hg	Silver	Ag
Curium	Cm	Molybdenum	Mo	Sodium	Na
Dysprosium	Dy	Neodymium	Nd	Strontium	Sr
Einsteinium	Es	Neon	Ne	Sulfur	S
Erbium	Er	Neptunium	Np	Tantalum	Ta
Europium	Eu	Nickel	Ni	Technetium	Tc
Fermium	Fm	Niobium	Nb	Tellerium	Te
Flourine	F	Nitrogen	N	Terbium	Tb

Appendix C Table
Elements
(continued)

Element	Symbol
Thallium	Tl
Thorium	Th
Thulium	Tm
Tin	Sn
Titanium	Ti
Tungsten	W
Uranium	U
Vanadium	V
Xenon	Xe
Ytterbium	Xc
Yttrium	Y
Zinc	Zn
Zirconium	Zr

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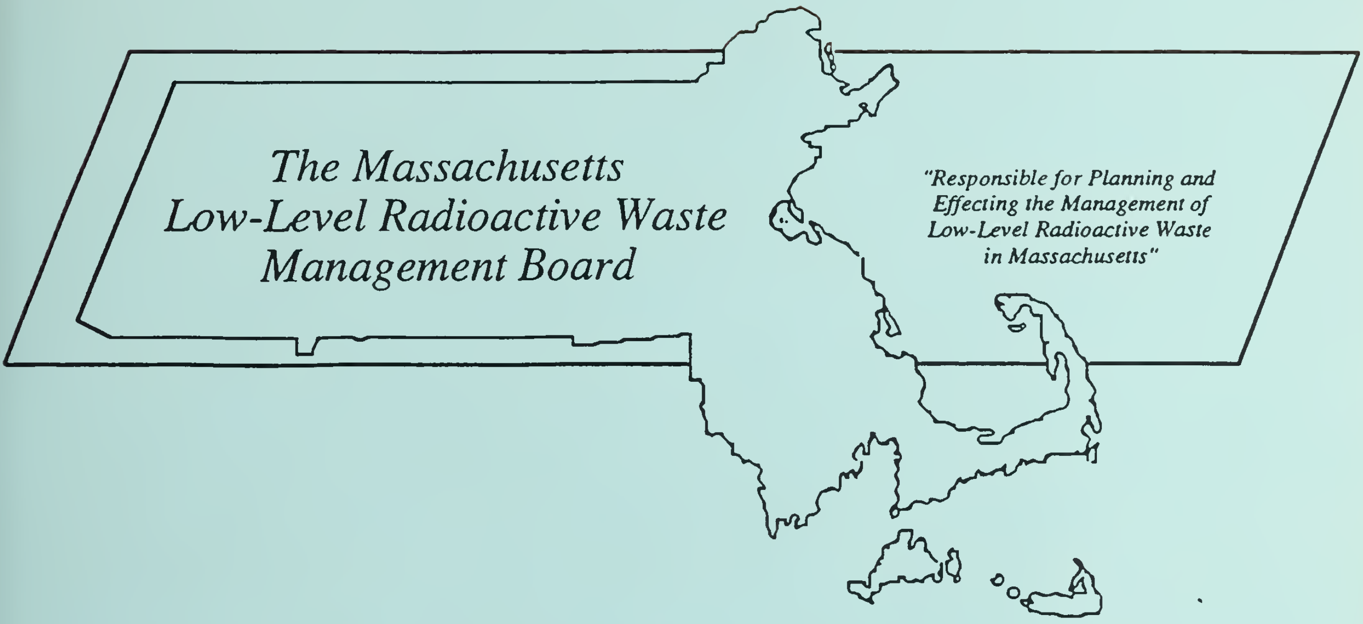

The Massachusetts
Low-Level Radioactive Waste
Management Board

"Responsible for Planning and Effecting the Management of Low-Level Radioactive Waste in Massachusetts"

1992 Massachusetts Low-Level Radioactive Waste Survey Report

October 1993

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October 1993

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1. Introduction

This report presents single year low-level radioactive waste (LLRW) characteristic data compiled from responses to the "1992 Low-Level Radioactive Waste Classification Survey" of radioactive material users In Massachusetts. The purpose of the annual LLRW survey is to determine the characteristics of LLRW produced, treated, stored, or disposed of by users of radioactive materials that are licensed by the U.S. Nuclear Regulatory Commission (NRC) or registered with the Massachusetts Department of Labor and Industries (DLI). Survey results are used to assist the Massachusetts Low-Level Radioactive Waste Management Board in establishing policy on LLRW storage, treatment, disposal, and other management methods. Additional copies of this report, and further information about its contents, can be obtained from the Management Board office, 100 Cambridge Street, Room 903, Boston, MA. 02202 (Telephone (617) 727-6018).

The survey fulfills the requirements of M.G.L. c.111H (Chapter 111H), the Massachusetts Low-Level Radioactive Waste Management Act. Section 7 of Chapter 111H requires that each person who generates, treats, stores, transports or disposes of LLRW within the Commonwealth shall annually provide detailed and accurate information concerning the type, volume, radioactivity, source, and characteristics of the LLRW produced as well as current and projected LLRW management activities, including source minimization, volume minimization, on-site storage, treatment, packaging, and transportation practices.

The annual survey enables Massachusetts to collect data for evaluation in the Management Board's "total hazard" classification system -- a process that categorizes all LLRW generated, treated, stored or disposed of not only on the basis of its radiological characteristics (such as radioactive half-life, principal radionuclides[1] and their concentrations present in the waste, radioisotopic quantities, etc.), but also on its chemical and biological toxicity, chemical radioactivity, form, and volume. This classification system is used by the Board to determine which classes of LLRW may be stored for decay,[2] which classes will require disposal, and which classes will require special management procedures to facilitate the safe and timely closure, post-closure observation and maintenance, and institutional control[3] of a facility accepting LLRW in the Commonwealth, should one be built.

---

[1] An atom is comprised of a nucleus of positive and neutral particles, known respectively as protons and neutrons, orbited by negative particles called electrons. Atoms with the same number of protons are classified as elements, such as Hydrogen (1 proton) or Uranium (92 protons). Isotopes of an element are atoms containing the same number of protons but different numbers of neutrons. A "radionuclide" or "nuclide" is an unstable isotope of an element (with an unbalanced proton to neutron ratio) that Is "radioactive," meaning it will emit energy in the form of particles and\or waves (radiation) In order to change from an unstable to stable form. Radionuclides have a defined "half-life" which Is the amount of time it takes for one-half of a given amount of radioactive material to "decay" or transform into another element, which may or may not be radioactive. There are over 700 known nuclides. See Appendix B for more Information.

[2] "Storage for decay" is a common treatment procedure, and is defined in Section 2 of this report.

[3] The "closure," "post-closure observation and maintenance" and "institutional control" phases of a facility involve the time, after waste is no longer accepted at the facility (closure), when the facility operator actively monitors and maintains the facility in preparation for the transfer of the facility license from the operator to the Commonwealth (post-closure observation and maintenance), and when the Commonwealth assumes responsibility for continued facility observation, monitoring and care (institutional control). In the case of a disposal facility, these phases could total several hundred years.

The Management Board is considering various options for the short-and long-term management of LLRW, including but not limited to the possibility of siting an in-state storage, treatment or disposal facility. If a decision is made to initiate facility siting, the data acquired from the annual survey will assist the Board and the site community in making management decisions that provide for safe, environmentally-sound, facility operation.

LLRW Generators

More than 440[4] hospitals, government agencies, biotechnology firms, and other businesses, including two nuclear power plants (one operational and another undergoing decommissioning), are licensed by the NRC or registered with the DLI to use or possess radioactive material in Massachusetts.

Much of the information in this report is grouped by "category" of generator, of which there are five:

(1) Academic (Acad) - universities, colleges, and other research institutions;

(2) Commercial (Comm) - organizations such as biotechnology, engineering, and construction companies; testing laboratories; radiopharmaceutical manufacturers and suppliers; and companies using radioactive materials for process and quality control and analysis;

(3) Government (Govt) - local, state, and federal entities, such as water districts, transportation authorities, and health departments;

(4) Health - hospitals, clinics, and physicians; and

(5) Utility - electricity generating power companies that operate nuclear power plants.

The categories listed above, while convenient for data analysis, do not acknowledge the interrelationship between them. For instance, commercial organizations produce products consumed by the medical and academic communities. A common example is the case of radiopharmaceuticals. An examination of the data will reveal that organizations in the "health" category typically do not ship large quantities of waste for disposal. This situation exists because "commercial" companies manufacture radioisotopes, from raw materials (from special nuclear reactors or other devices), and deliver the final product to "health" organizations; any waste generated during the production phase is retained by the manufacturer, and hence falls within the "commercial" category. Therefore, although the end use of radioactive materials by hospitals does not generate large quantities of "long-lived" LLRW, the production of health-care radionuclides and radiopharmaceuticals by commercial entities does produce long-lived LLRW.

LLRW is generated as a by-product of various uses of radionuclides. Typical applications include:

(1) medical procedures such as cancer and thyroid dysfunction diagnosis and treatment, radioimmunoassay, and diagnostic imaging examinations;

(2) research and development in the biotechnology industry for the treatment and prevention of various diseases and medical dysfunctions, and in the environmental field to study the

---

[4] The total number of radioactive material licensees in Massachusetts varies from time to time due to the expiration or termination of some licenses and the issuance of new ones.

of various diseases and medical dysfunctions, and in the environmental field to study the effects of chemicals on plant and aquatic life, and for ocean studies;

(3) commercial uses such as within instruments that measure level, thickness, and density or that are used in moisture analysis and quality control; sealed sources that are used for industrial radiography of pressure vessels and other structural welds; smoke detectors and exit signs in buildings;

(4) university education and research in medicine, materials science, and biotechnology; and

(5) the production of electricity by a nuclear power plant.

LLRW takes a variety of forms and includes: radioactively contaminated dry, solid wastes such as wood, clothing and metal; concentrates from evaporation processes; hardware that has been irradiated as a result of proximity to certain nuclear radiation sources; filters and filter media used in purifying various process streams; ion exchange resins used in water purification and chemical extraction processes; contaminated aqueous and organic liquids used in various analytical procedures and decontamination processes; contaminated used oils from machinery and processes which use radioactive materials; contaminated soil and rubble from the decommissioning and remediation of various facilities; biological waste such as animal carcasses and tissues from biological and medical research and medical diagnosis and treatment; and sludges from various processes.

Just as the physical form of LLRW varies, so does its content of radioactive material and intensity of radiation emitted. Over 80 percent of waste generated in Massachusetts contains only trace amounts of radioactivity which emit slight amounts of radiation. But, a small percentage of waste, typically produced by nuclear power plants and manufacturers of sealed sources, contains radioactivity which emits high levels of radiation. More information can be found in Section 7: "Evaluating the 1992 Data for Policy-Making Purposes." Types of LLRW materials that typically comprise the waste stream in Massachusetts, the categories of generators producing each type, frequently used treatment processes, and the kinds of containers used for storage and disposal are summarized In Table 1.

Table 1
Typical LLRW Categories, Treatment, and Packaging

Waste Category	Generator Categories Typically Producing Waste	Typical Treatment Used	Container Types Used For Storage and/or Disposal
Dry Active Waste (DAW) (Uncompactable) metal, concrete, wood, hardware	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	none, decontamination, segregation, sorting, recycle, decay	55 & 30 gallon steel drums, steel boxes
Dry Active Waste (DAW) (Compactable) paper, cloth, clothing, glassware, plastic	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	compaction, incineration, segregation, sorting, decay	55 & 30 gallon steel drums, steel boxes, steel cargo vans, plastic boxes
Evaporator Concentrates	UTILITY	evaporation, solidification w/cement or polymers	55 gallon steel drums, steel liners
Cartridge Filters for Liquids	ACADEMIC, UTILITY	none, dewatering, solidification w/cement or polymers	55 & 30 gallon steel drums, steel boxes, HIC

Table 1
Typical LLRW Categories, Treatment, and Packaging (continued)

Waste Category	Generator Categories Typically Producing Waste	Typical Treatment Used	Container Types Used For Storage and/or Disposal
Activated Hardware control rods, in-core instruments, structural materials	ACADEMIC, UTILITY	size reduction	55 gallon steel drums, steel liners, HIC
Contaminated Hardware	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	none, decontamination, decay	55 & 30 gallon steel drums, steel boxes
Ion Exchange Resins (Solidified)	COMMERCIAL, UTILITY	solidification w/cement or polymers	55 gallon steel drums, steel liners, HIC
Ion Exchange Resins (Dewatered)	COMMERCIAL, ACADEMIC, UTILITY	dewatering to < 0.5% free water	55 gallon steel drums, steel liners, HIC
Contaminated Aqueous Liquids	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT	incineration, decay, sewerage disposal[5]	55 & 30 gallon steel drums
Contaminated Oils	COMMERCIAL, UTILITY	incineration, solidification, absorption	55 & 30 gallon steel drums, steel liners
Other Contaminated Organic Liquids	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	incineration, decay	incinerated or stored in: 55 & 30 gallon steel drums
Contaminated Rubble, Soil, Sand, etc.	COMMERCIAL, ACADEMIC	none	55 & 30 gallon steel drums, steel boxes, HIC
Other Sludge	COMMERCIAL, UTILITY	dewatering to < 0.5% free	55 & 30 gallon steel drums,
Biological Waste carcasses, tissue	COMMERCIAL, ACADEMIC, HEALTH	incineration, double containers with absorbents and lime	55 & 30 gallon steel drums, steel boxes, HIC
Depleted Uranium Sludges and Metals	COMMERCIAL	recycling, solidification	55 gallon steel drums, steel boxes

Notes:

(1) HIC means High Integrity Container, designed to withstand the effects of disposal for a minimum of 300 years.

(2) Not all waste streams, processes, or containers appear in a given year or from a specified generator category each year.

(3) "Steel liners" are typically large cylindrical vessels ranging in capacity from 50 to 215 cubic feet capacity.

(4) Other containers used less frequently include small steel pails or cans in the 1/2 to 5 gallon size and 9 to 10 cubic feet fiber drums used as temporary containment vessels prior to processing such as incineration (where the fiber drum is incinerated also).

(5) NRC regulations (10 CFR 20) permit minute concentrations of certain radionuclides to be discharged into sanitary sewerage systems.

1992 Survey Report Contents

The annual waste classification survey requests information regarding LLRW disposal practices for the survey year and projections for the next three years. Data are presented in the subject order of waste production, treatment, shipment for disposal in a licensed disposal facility, placed in storage on site for future off-site disposal, storage for decay, or managed by "other methods" (such as release into effluents or incineration, return to supplier, or other authorized disposal procedures). Information on waste producers, radioactivity, and the 1992 survey form and code sheet can be found in the Appendices. Table and figures in this report present values rounded by standard methods, and totals may not equal 1 percent.

2. Waste Management Methods

Radioactive materials licensees are regulated by the NRC under Title 10 of the Code of Federal Regulations (CFR). Part 20 of Title 10 (10 CFR 20) pertains to standards to protect against radiation hazards; Part 35 (10 CFR 35) pertains to medical use of byproduct material; Part 61 (10 CFR 61) pertains to land disposal of radioactive waste, and Part 71 (10 CFR 71) regulates packaging and transportation.

After LLRW is produced, the generator currently has several waste management options available. The waste can be shipped to a licensed LLRW disposal facility, held in storage for decay, placed in storage for future off-site disposal, or managed by other approved methods. Because of the costs of managing LLRW, generators have been forced to research numerous alternatives to handle and reduce waste forms and volumes. Terms frequently used in this report to describe various management options, include:

"Volume or radioactivity shipped for disposal" represents LLRW shipped to a licensed LLRW disposal facility. Disposal facilities available during 1992 were: Barnwell, South Carolina; Hanford, Washington; Beatty, Nevada, and Clive, Utah. Volume information is also given by "disposal class" which refers to the NRC disposal classification system contained in 10 CFR 61. Four classes of waste are defined:

> **Class A** wastes are characterized by their low concentrations of long-lived radionuclides and concentrations of short-lived radionuclides that will decay to acceptable levels within a 100-year institutional control period when a disposal facility is actively maintained after closure. These concentration limits, specified in 10 CFR 61, have been calculated on the basis of acceptable dose limits to an individual who might inadvertently intrude, occupy the disposal site, and encounter waste after this time.
>
> **Class B** wastes are the next level of wastes that could represent a potential hazard to an inadvertent intruder without additional protective measures, since they contain higher concentrations of short-lived and long-lived radionuclides. They must meet the NRC's minimum stability requirements so that the waste forms or containers can "maintain gross physical properties and identity, over 300 years" [Part 61.7(b)(2)], thus limiting the exposure to a potential intruder.
>
> **Class C** wastes are wastes that, due to their greater concentrations of long-lived or short-lived radionuclides, must meet more stringent waste form requirements to ensure stability, and must be disposed of in such a way to protect the inadvertent intruder for a longer period of time. These wastes must meet the stability requirements for form or container (300 years) and must be disposed of in a manner which protects against inadvertent intrusion for at least 500 years [Part 61.7 (b)(5)].
>
> **Greater than Class C** (GTCC) wastes are wastes whose concentrations of radioactive isotopes generally make them unacceptable for the types of disposal available to classes A, B and C. GTCC wastes continue to be the responsibility of the federal government.

"LLRW volume placed in storage for future off-site disposal" refers to LLRW being held in storage, either on or off-site, pending future disposal. Volume reported as stored may not reflect the final disposal volume, since the waste may be treated prior to disposal. Waste is commonly held on site for consolidation prior to shipment, for partial radioactive decay, or if disposal capacity is not available (see "mixed waste" below).

"Storage for decay" refers to a procedure where LLRW, with a relatively short half-life, is held for natural radioactive decay in compliance with applicable federal (10 CFR 35 § 35.92) and state regulations. At the end of the storage period, the waste effectively is no longer radioactive and, after radiation monitoring, it can be disposed of as normal trash. Massachusetts Law (Chapter 111H) defines storage for decay as a treatment method.

"Mixed waste" is radioactive material that is contaminated by, or exhibits the characteristics of, toxic chemical "hazardous" material, as defined by both the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP). In Massachusetts, mixed waste is classified using the same NRC disposal classifications listed above with the addition of an "H" for "hazardous" after the classification letter (i.e., Class AH, Class BH, etc.).

A recent report prepared by Oak Ridge National Laboratory for the NRC[5] indicates that there is sufficient treatment capacity nationally for all mixed waste categories except chlorinated fluorocarbons, lead shielding and other lead contaminated waste, and mercury contaminated equipment and debris. But, the report also points out, a large amount of mixed waste remains in storage for various reasons, including: regulatory uncertainty, lack of resources (funds or manpower), and lack of knowledge of and\or experience with treatment facilities.

During 1992 none of the "problem" mixed wastes (CFC's, lead, mercury) were reported generated. In Massachusetts, the majority of mixed waste reported produced was liquid scintillation fluid (LSF) which meets the criteria of 10 CFR 20 §20.2005. Adequate treatment capacity (incineration) for this waste exists and is being utilized. See Section 5 for more information.

"Other management methods" refers to:

(1) small quantities of radioactive materials discharged to sewers or released into the atmosphere in accordance with standards set in 10 CFR 20 (see below);

(2) on-site incineration under 10 CFR 20 § 20.2004;

(3) return to the manufacturer\supplier under 10 CFR 20 § 20.2006; and

(4) recycle\recover which refers to the reuse of materials, typically tools or hardware, after decontamination.

Waste discharged into sanitary sewers, as allowed by 10 CFR 20, must be readily soluble liquid or a dispersable biological material in water [10 CFR 20.2003(a)(1)]. Strict concentration limits must also be observed so that proper dilution takes place. Atmospheric releases are approved by the NRC on a case-by-case basis.

Incineration is a volume reduction treatment technique. Ash remaining, if radioactive, is handled as LLRW, and is packaged and shipped to a disposal site. Some hospitals and universities incinerate on site; most LLRW generators, however, ship their waste out of state for this treatment.

Organizations that return waste to the supplier are typically users of what are known as "sealed sources." A sealed source is radioactive material encapsulated in a non-radioactive metal shell (like steel) that prevents the release of radioactive contamination to the environment. The shell allows radiation to be released so it can be used for various controlled purposes, such as the inspection of pipe welds or within instruments. A sealed source is usually returned to the supplier when, due to radioactive decay, the amount of energy being released is so small that it is no longer useful. Other materials or "wastes" typically returned to the supplier include radiopharmaceuticals stored for decay.

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[5] U.S. Nuclear Regulatory Commission. National Profile on Commercially Generated Low-Level Radioactive Mixed Waste. NUREG\CR-5938. Washington, DC: December 1992.

Waste Avoidance

Due to the increasing cost of LLRW disposal and the uncertainty of access to disposal facilities, Massachusetts LLRW producers are increasingly practicing "waste avoidance" which involves managing waste by methods other than shipping for disposal, avoiding unnecessary contamination of materials, and the substitution of non-radioactive materials into processes when possible. Waste avoidance techniques reduce the volume of waste shipped to licensed disposal sites. The following data from the U.S. Department of Energy (DOE) shows how Massachusetts compared to other states in 1992. Note that DOE data does not include LLRW shipped to the Envirocare facility in Clive, Utah, to which Massachusetts shipped 60,486 cubic feet and 2.4 curies in 1992.

Table 2
DOE Data on 1992 Volume and Radioactivity Shipped for Disposal by State

State	Volume (cu ft)	Radioactivity (curies)	State	Volume (cu ft)	Radioactivity (curies)
Illinois	285,023	103,273	Maine	8,789	8,110
Texas	162,844	4,057	Kansas	8,196	1,319
Oregon	147,682	742	Wisconsin	6,896	571
California	112,946	15,730	Arkansas	6,497	32,562
Pennsylvania	93,050	141,248	Vermont	5,390	20,513
Virginia	92,747	1,154	Iowa	5,448	42,085
Tennessee	83,792	1,595	Utah	5,380	108
Washington	79,290	10,663	New Mexico	3,483	56
New York	70,272	90,377	Hawaii	2,932	3
North Carolina	61,777	57,505	Indiana	2,733	27
Massachusetts	**56,734**	**76,588**	Kentucky	2,195	26
Connecticut	53,032	29,392	South Dakota	1,712	1
South Carolina	45,782	3,088	D. of Columbia	1,598	31
Minnesota	40,194	59,979	Delaware	988	1
New Jersey	38,032	47,959	Army outside U.S.	445	1
Colorado	33,863	32,978	Rhode Island	374	1
Georgia	29,344	40,312	West Virginia	192	31
Oklahoma	28,062	60	Alaska	143	568
Louisiana	24,744	4,683	Montana	140	7
Florida	23,535	996	Nevada	134	18
Ohio	22,207	3,440	North Dakota	99	67
Alabama	20,351	53,669	Idaho	51	2
Arizona	19,001	997	New Hampshire	8	[illegible]
Maryland	17,854	8,421	Wyoming	3	5
Mississippi	12,623	2,669	Puerto Rico	0	0
Nebraska	12,617	101,284	Michigan	0	0
Missouri	11,315	1,128	Total	1,743,279	1,000,102

3. Summary of 1992 Survey Data

The 1992 LLRW Classification Survey was mailed to all NRC licensees, those Massachusetts Department of Labor and Industries registrants who were registered to possess sources of ionizing radiation that were surveyed in 1991, and organizations surveyed in 1991 that cancelled their NRC license during 1992. The total number of organizations surveyed was 441.

Of those surveyed, 263 (60%) indicated their use of radioactive materials resulted in the production of LLRW; the remainder used sealed sources or did not possess radioactive materials during 1992. Of the 263 organizations that produced LLRW, 106 indicated they had shipped waste to one of the four licensed disposal facilities; the remainder managed their waste by methods such as storage for decay, and did not ship waste for disposal. Some generators managed their waste by a combination of methods, including shipment for disposal, storage for decay, etc. Table 3 and Figures 1 and 2 illustrate LLRW production and management by each generator category.

Production and Disposition Summary

During 1992, Massachusetts produced 349,392 cubic feet of LLRW, of which:

- 177,933 cubic feet (51%), containing 27,142 curies, was managed by methods not resulting in shipment for disposal;

- 52,451 cubic feet (15%) was eliminated by broker\processor treatment; and

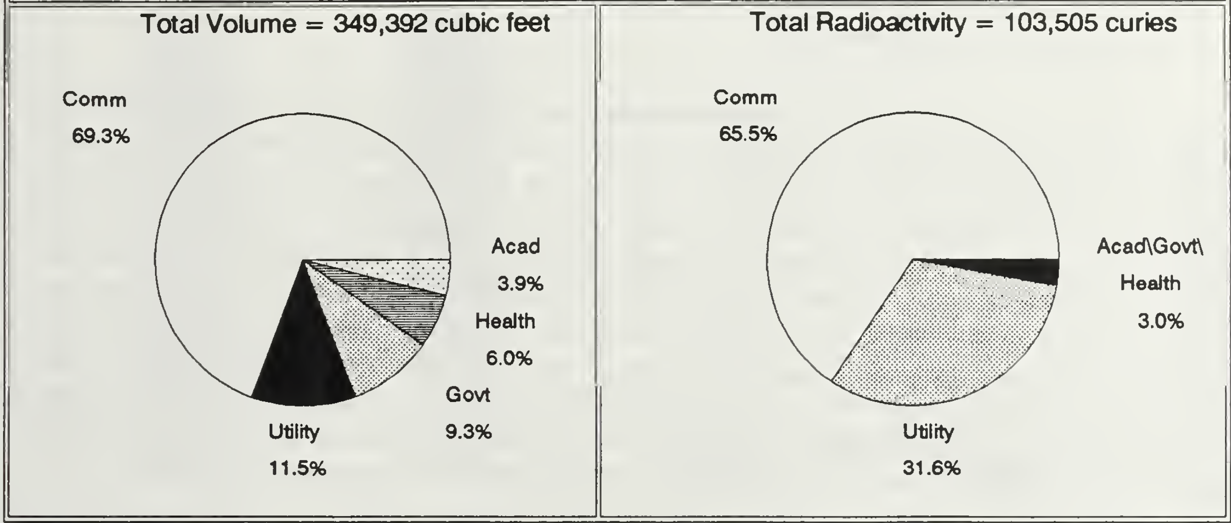
- 119,004 cubic feet (34%), containing 76,363 curies of radioactivity, was shipped for disposal.

Table 3
Summary of 1992 LLRW Production and Disposition
(cubic feet)

	Generator Category						% of
Production\Disposition	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**Total**
Produced	13,524.6	242,167.5	32,351.7	21,026.3	40,322.1	349,392.2	100.0
Waste Avoidance							
Placed in Storage	98.0	2,002.5	7.9	44.0	445.7	2,598.0	0.7
Storage for Decay	7,786.1	18,108.1	33.0	15,301.8	0.0	41,229.0	11.8
Incineration (in State)	1,646.4	14.9	0.0	1,495.3	0.0	3,156.6	0.9
Return to Manufacturer\Supplier	0.0	291.2	0.5	911.1	0.0	1,202.8	0.3
Recycle\Recover	0.0	155.0	0.0	0.0	0.0	155.0	0.0
Sewerage Release	340.9	126,178.5	0.0	397.3	0.0	126,916.7	36.3
Atmospheric Release	0.0	2,675.0	0.0	0.0	0.0	2,675.0	0.8
Total	9,871.4	149,425.2	41.4	18,149.5	445.7	177,933.1	50.9
Broker\Processor Treatment							
Shipped to:	3,653.2	28,564.5	296.6	2,875.7	28,544.4	63,934.5	N/A
Shipped from:	1,276.1	6,760.0	296.6	976.8	2,173.4	11,483.0	N/A
Volume Eliminated	2,377.1	21,804.5	0.0	1,898.9	26,371.0	52,451.5	15.0
Shipment for Disposal	1,276.1	70,934.8	32,310.3	977.6	13,505.4	119,004.2	34.1

Figure 1 provides a breakdown of waste volume and radioactivity production by generator category. By volume, the largest contribution (69%) is from the commercial category, followed by 11% from the utility and the remaining 9%, 6%, and 4% respectively from the government, health, and academic categories. By radioactivity, the largest contribution (65%) is also from the commercial category, followed by 32% from the utility and the remaining 3% from the health, academic and government categories, combined.

Figure 1
1992 LLRW Volume and Activity Produced – by Generator Category
(percent)


Total Volume = 349,392 cubic feet

Total Radioactivity = 103,505 curies

The 1992 Massachusetts LLRW stream was dominated by "decommissioning" waste. During the year, decommissioning began at the U.S. Army Materials Technology Laboratory test reactor at the Watertown Arsenal. In addition, Texas Instruments, Incorporated conducted a remediation project at a site in Attleboro, which previously had been authorized by the NRC for burial of radioactive materials. Waste from these projects boosted the amount of LLRW volume Massachusetts was expected to ship for disposal (estimated in 1991 to be 30,000 cubic feet annually) by approximately four.

The Army reactor decommissioning and Texas Instruments site remediation projects produced large quantities of a type of LLRW known as high volume, low activity (HVLA) waste. HVLA waste is typically comprised of soils or building rubble containing very small amounts of radioactivity. For example, Texas Instruments shipped 48 rail cars holding 54,719 cubic feet of waste containing only 0.765 curies of activity to the Envirocare disposal facility in Clive, Utah and the Army shipped 25,770 cubic feet of waste containing 0.29 curies to the disposal facility in Barnwell, South Carolina. Together, Army and Texas Instruments wastes accounted for 25% of the total amount of 1992 LLRW volume produced and 73% of 1992 LLRW volume shipped for disposal.

During 1992, Yankee Atomic Electric Company shipped 115 cubic feet of irradiated reactor hardware (metals that have become radioactive by being exposed to neutrons in the reactor core) containing 32,080 curies of radioactivity, from its Rowe, Massachusetts, plant to the Barnwell disposal site. Major nuclides (with their half–lives in parentheses) contained in this waste include:

–Silver–110 (253 days), 12,350 curies;

–Iron–55 (2.7 years), 8,320 curies;

–Cobalt–60 (5.3 years), 6,910 curies;

–Cadmium–109 (1.2 years), 2,550 curies; and

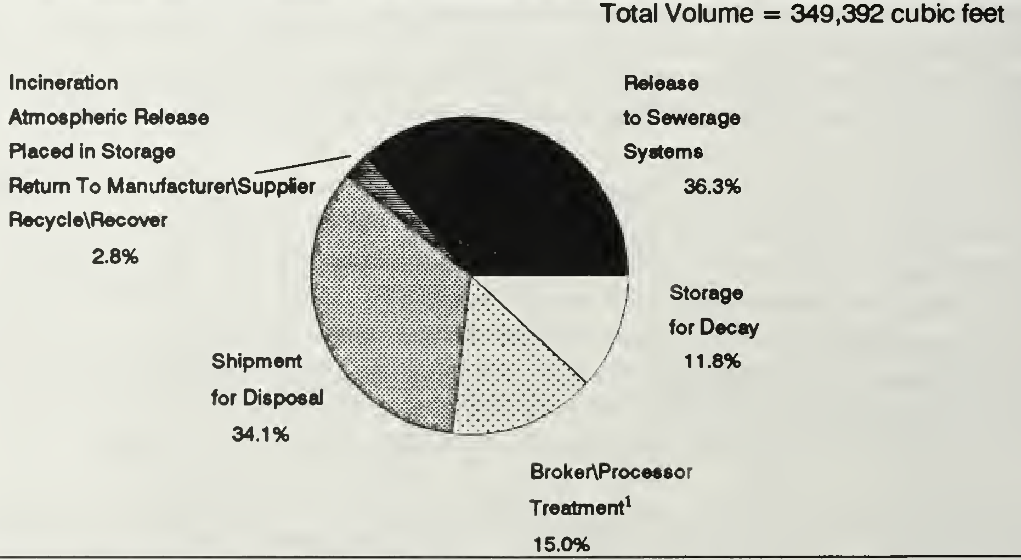
–Nickel–63 (100 Years), 804 curies.

As illustrated by Figure 2, the largest percentage of waste volume produced, 36%, was managed by disposal into sanitary sewers. The largest contributor was Interstate Nuclear Services, operator of a nuclear laundry, that discharged 124,178 cubic feet of washing machine effluents containing 0.223729 curies of radioactivity during 1992. Shipment for disposal (34%) accounts for the second largest portion of waste volume produced. Storage for decay (12%) accounts for the third largest amount of LLRW volume produced during 1992. The remaining waste management practices, including incineration (in–state) of waste within the regulatory limits of 10 CFR 20, recycling, storage, and return to the manufacturer or supplier accounted for a much smaller percentage of the LLRW volume produced during 1992. The data also illustrate the dependence of licensees on out–of–state broker\processor treatment facilities. During 1992, treatment processes, including incineration, compaction, and decontamination, eliminated over 15% of the waste volume produced.

Figure 2

Disposition of 1992 LLRW Volume Produced – by Management Method

(percent)



[1] Treatment at out–of–state facilities.

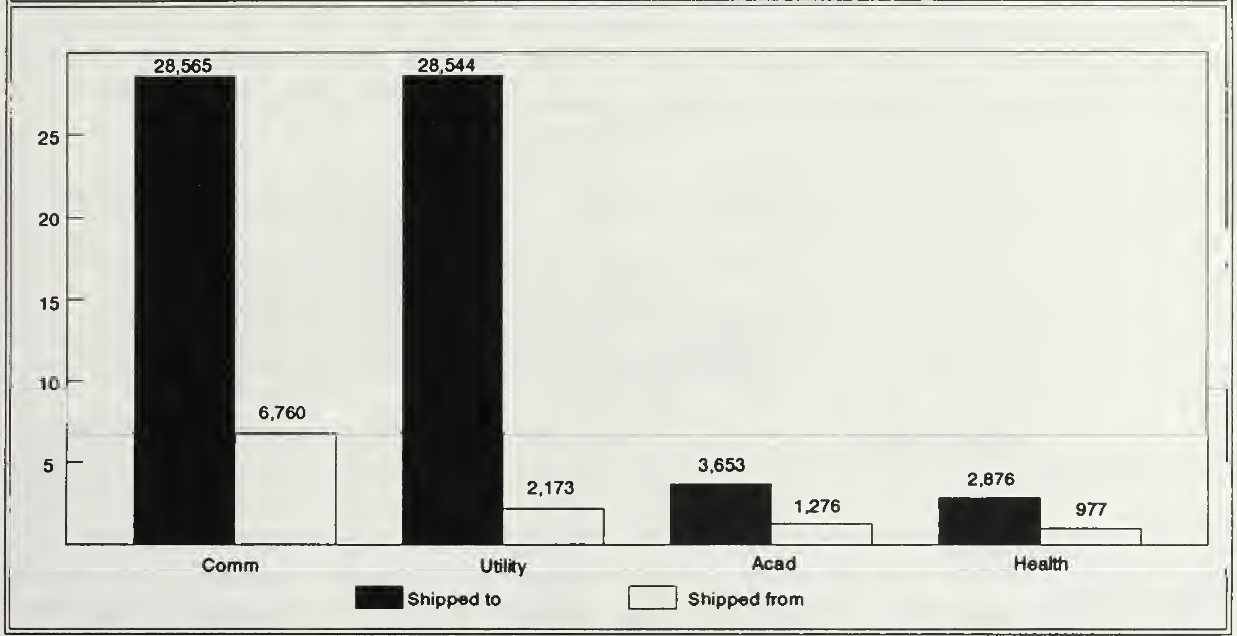
Treatment Summary

Figure 3 illustrates the volume of waste delivered to treatment facilities and shows the amount of waste "volume eliminated" from each generator category.

Figure 3

1992 LLRW Out-of-State Treatment Results – by Generator Category

(thousands of cubic feet)



Many licensees take advantage of commercial treatment services, offered by out-of-state companies, since the price of disposal is based on the volume of waste delivered to the disposal facility. Typically, waste is picked up at the point of generation by "brokers" (companies in the business of arranging for treatment and\or disposal of radioactive materials and wastes). Frequently a broker will make multiple pickups, both in and out of state, before reaching an LLRW treatment facility. "Processors" are companies that operate radioactive waste treatment facilities; in some cases brokers are also processors.

There are a wide range of treatment processes available to the LLRW producer. Certain wastes must be processed to modify their physical form, to make them suitable for disposal. For example, liquids are often solidified into concrete. Other wastes do not require treatment prior to disposal, but are frequently shipped to treatment facilities for volume reduction processing because of the cost effectiveness that results for disposal. These treatment processes reduce LLRW volume shipped for disposal, but generally do not reduce the radioactivity of the waste.

Further information on treatment results for specific waste categories and processes can be found in Section 4, "Characteristic Data of 1992 Massachusetts LLRW."

Shipment for Disposal Summary

During 1992, Massachusetts radioactive materials users shipped for disposal 119,004 cubic feet of LLRW, containing 76,363 curies of radioactivity. This amount represents 34% of the total waste volume produced. As indicated by Table 4 below, the majority of LLRW volume shipped for disposal falls within the dry active waste (DAW) category, while the largest amounts of radioactivity result from the disposal of absorbed liquids and irradiated reactor components.

"DAW–Bulk Materials" includes paper, plastic, glass, cloth, and soil; while "DAW–Solids" comprises wood, metal, concrete, and equipment. "Absorbed liquids" refers to liquids soaked up in granular materials (like "speedi–dry"); "irradiated reactor components" are equipment that has become radioactive from exposure to neutrons in a nuclear reactor.

Table 1 and the survey code sheet in Appendix C provide additional LLRW category information.

Table 4
1992 LLRW Volume and Radioactivity Shipped for Disposal – by Waste Category
(cubic feet and curies)

Waste Category[1]	Volume (cubic feet)	% of Total	Radioactivity (curies)	% of Total
DAW–Bulk Materials	87,166.1	73.2	159.2631	0.2
DAW–Solids	12,235.1	10.3	608.5996	0.8
DAW–Compacted Bulk Material	5,325.1	4.5	432.9833	0.6
Solidified Liquids	3,673.3	3.1	352.6009	0.5
Dewatered Ion Exchange Media	3,291.7	2.8	572.6608	0.7
Other Dewatered Sludges	2,880.0	2.4	1.4015	0.0
Absorbed Liquids	1,377.8	1.2	42,078.6022	55.1
Dewatered Filter Media	1,029.0	0.9	17.3812	0.0
Aqueous Liquids	577.5	0.5	36.0675	0.0
Contaminated Metal Objects	400.0	0.3	0.0009	0.0
DAW–Compacted Solids	304.3	0.3	0.2979	0.0
Sealed Sources	175.8	0.1	20.2560	0.0
Contaminated Oil/Lubricant	140.7	0.1	2.4977	0.0
Irradiated Reactor Components	114.8	0.1	32,080.0000	42.0
Biological Waste or Carcasses	108.4	0.1	0.0660	0.0
Cartridge Filters	90.0	0.1	0.0014	0.0
DAW–Medical Wastes	42.0	0.0	0.0033	0.0
Other Solidified Sludges	41.5	0.0	0.0190	0.0
Incinerator Ash	15.0	0.0	0.0048	0.0
Gases in Sealed Containers	8.0	0.0	0.0003	0.0
Other Irradiated Materials	8.0	0.0	0.0003	0.0
Total	119,004.2	100.0	76,362.7074	100.0

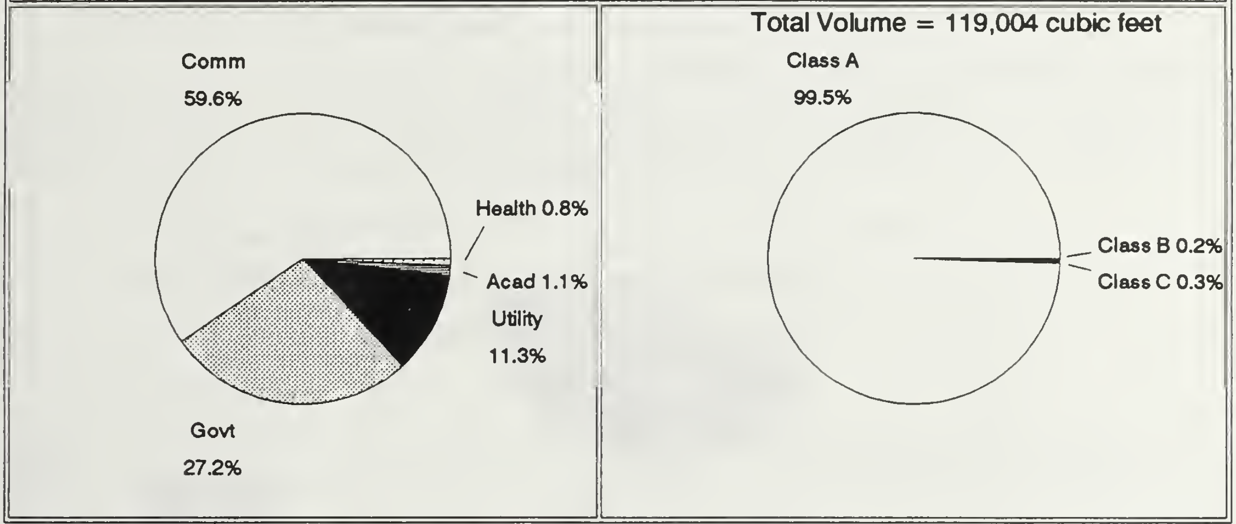
[1] See Table 1 for a description of waste categories.

Figure 4 provides a breakdown of volume shipped for disposal by generator category and disposal class. The largest contributor to 1992 LLRW volume shipped for disposal is the commercial category (60%), followed by government (27%), utility (11%), academic (1%) and health (1%).

Figure 4

1992 LLRW Volume Shipped for Disposal – by Generator Category and Waste Class

(thousands of cubic feet)



Although Massachusetts ranks among the top 15 states shipping waste for disposal in the country, the state's waste stream is unique in that the commercial sector usually ships more volume (and typically radioactivity) for disposal than other generator categories. There are two main reasons for this phenomenon. First, Massachusetts, with two nuclear power plants, has a smaller nuclear LLRW component then other large waste producing states. Among the top 15 states, Massachusetts has the second fewest number of nuclear power plants (Oregon has one). The second reason is that Massachusetts is home to the Dupont companies (within the commercial category), who are the largest manufacturers of radiopharmaceuticals in the country.

As illustrated by Figure 4, Class A waste comprises over 99% of waste volume shipped for disposal. Radionuclide and concentration limits defining Class A LLRW are such that radioactivity within the waste will decay within a 100–year institutional control period, when a facility is actively maintained after closure, to levels that would provide an acceptable dose to an inadvertant intruder (a person who might inadvertantly occupy a disposal site and encounter waste).

Less than 1% of LLRW volume shipped for disposal in 1992 was Class B and C. Because these wastes, produced in Massachusetts by nuclear power plants and a few commercial generators, contain larger concentrations of long–lived radionuclides, they must be placed in containers that will maintain their integrity for at least 300 years after disposal. In addition, Class C waste must be surrounded by barriers that will protect against inadvertant intrusion for at least 500 years.

Figure 5 provides a breakdown of radioactivity shipped for disposal by generator category. The The largest contribution is from the commercial category (57%), followed by the utility category with 43%; the remaining 0.1% is from the academic, government, and health categories combined.

Figure 5
1992 LLRW Radioactivity Shipped for Disposal – by Generator Category
(percent)

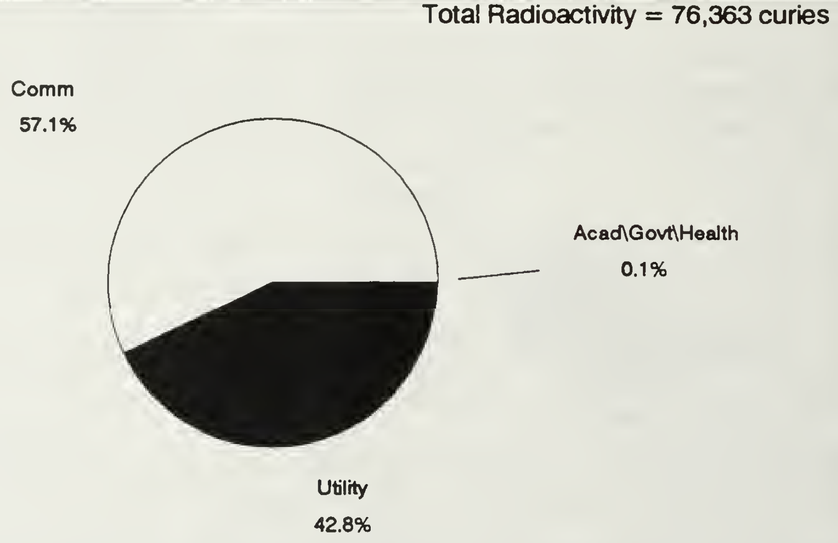

Total Radioactivity = 76,363 curies

Table 5 lists radionuclides contributing more than 1% of radioactivity in 1992 LLRW shipped for disposal and the generator category contributing the greatest amount of that nuclide; a complete list of radionuclides can be found in Appendix B.

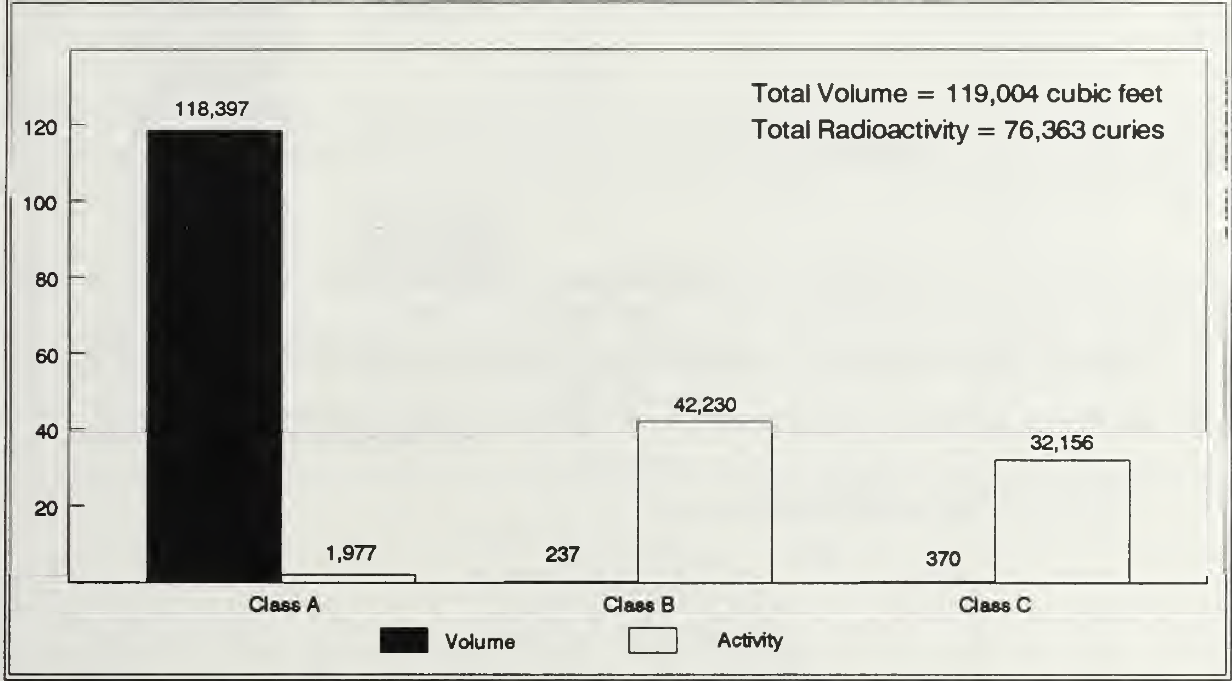
Table 5
Radionuclides Contributing more than One Percent to 1992 Radioactivity Shipped for Disposal
(curies)

Radionuclide	Half-life (years)	Radioactivity curies	% of Total Shipped	Major Contributor
Hydrogen-3 (Tritium)	12.3	42,769.9355	56.0	Commercial
Silver-110m	0.7	12,350.0916	16.2	Utility
Iron-55	2.7	8,482.0658	11.1	Utility
Cobalt-60	5.3	7,162.9610	9.4	Utility
Cadmium-109	1.3	2,550.0967	3.3	Utility
Nickel-63	100.0	819.7190	1.1	Utility
Remaining Nuclides	N/A	2,227.8379	2.9	N/A
Total	N/A	76,362.7074	100.0	

Figure 6 illustrates the relationship between disposal class and radioactivity of 1992 LLRW shipped for disposal. Class A waste, while being the largest class by volume (99.5%), contains the least amount of radioactivity (2%). Class B waste, while being the smallest amount by volume (0.2%) contains the greatest amount of radioactivity (55%). The greatest contributor to Class B radioactivity, 41,776 curies, is from DuPont Medical Products Company, a commercial licensee that typically ships large amounts of tritium (an isotope of Hydrogen with a 12.3 year half-life) waste as a result of manufacturing radiopharmaceuticals and radiolabelled compounds used in life-sciences research.

Class C waste, like Class B, also comprised a small amount of the volume shipped for disposal (0.3%) but a large amount of the radioactivity (42%). As noted earlier in this report, the largest contributor to Class C radioactivity was a shipment of reactor hardware from Yankee Atomic Electric Company's nuclear power plant in Rowe, Massachusetts.

Figure 6
1992 LLRW Volume and Radioactivity Shipped for Disposal – by Waste Class
(thousands of cubic feet and curies)



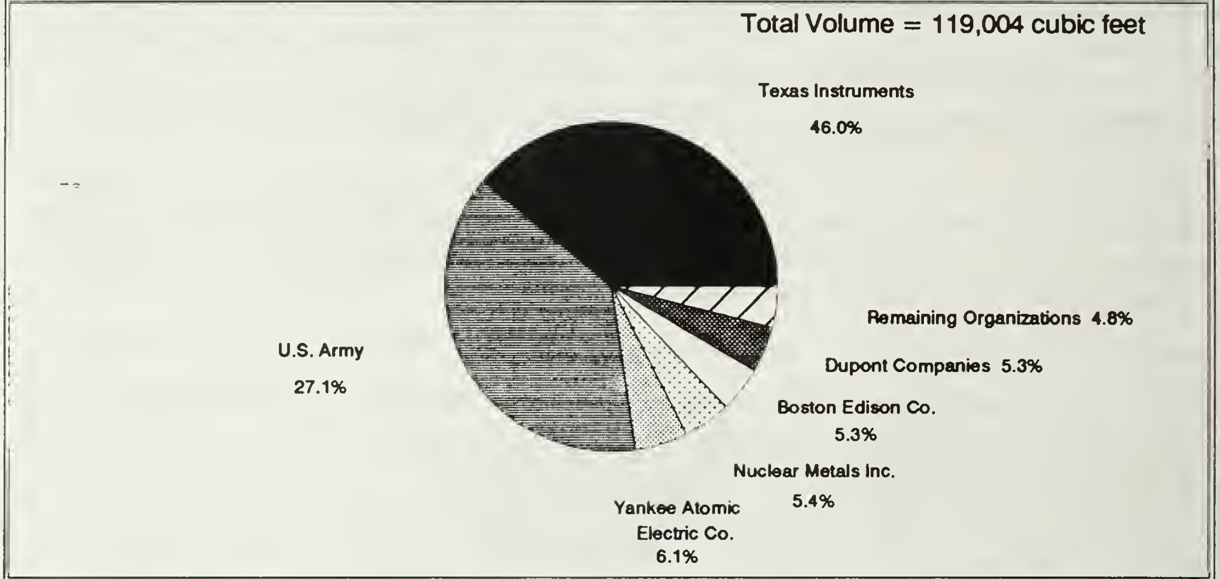
Major LLRW Shippers in 1992

As discussed in the production and disposition summary, the majority of LLRW volume and radioactivity is produced by the commercial category. Major generators of volume and radioactivity are presented in Figures 7 and 8. Additional information on waste volumes, reasons for the use of radioactive materials, treatment methods, and shipping information for each organization that reported producing waste in the Commonwealth during 1992 can be found in Appendix A.

Figure 7

Ranking by Volume of Organizations that Shipped LLRW for Disposal in 1992

(percent)

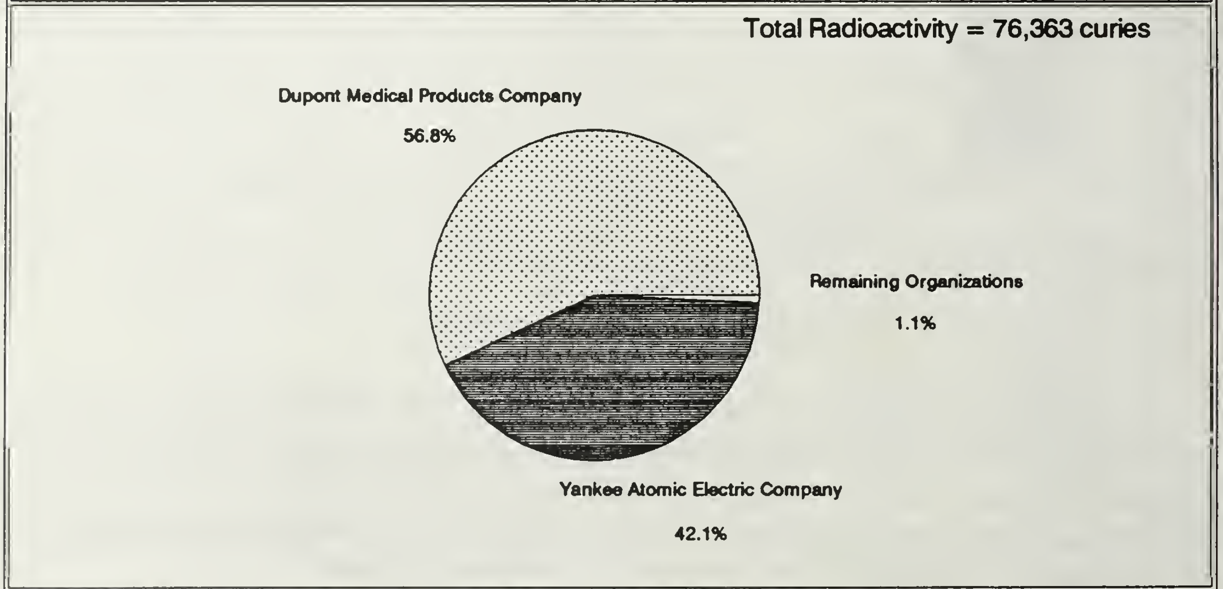


Dupont Companies = Du Pont Medical Products Co., Du Pont Merck Pharmaceutical Co., and E.I. Du Pont De Nemours Co.

Figure 8

Ranking by Radioactivity of Organizations that Shipped LLRW for Disposal in 1992

(percent)



Storage for Future Disposal Summary

LLRW generators place waste in storage for several reasons. They include consolidation prior to shipment, partial radioactive decay, a real or perceived lack of disposal capacity (as is the case for mixed waste) or to await treatment prior to disposal. During 1992, 2,598 (0.7%) of the 349,392 cubic feet of LLRW produced was placed into storage. Figure 9 and Figure 10 illustrate the quantity of LLRW placed in storage respectively by generator category and disposal classification.

Figure 9

1992 LLRW Volume Placed in Storage for Future Disposal – by Generator Category

(cubic feet)

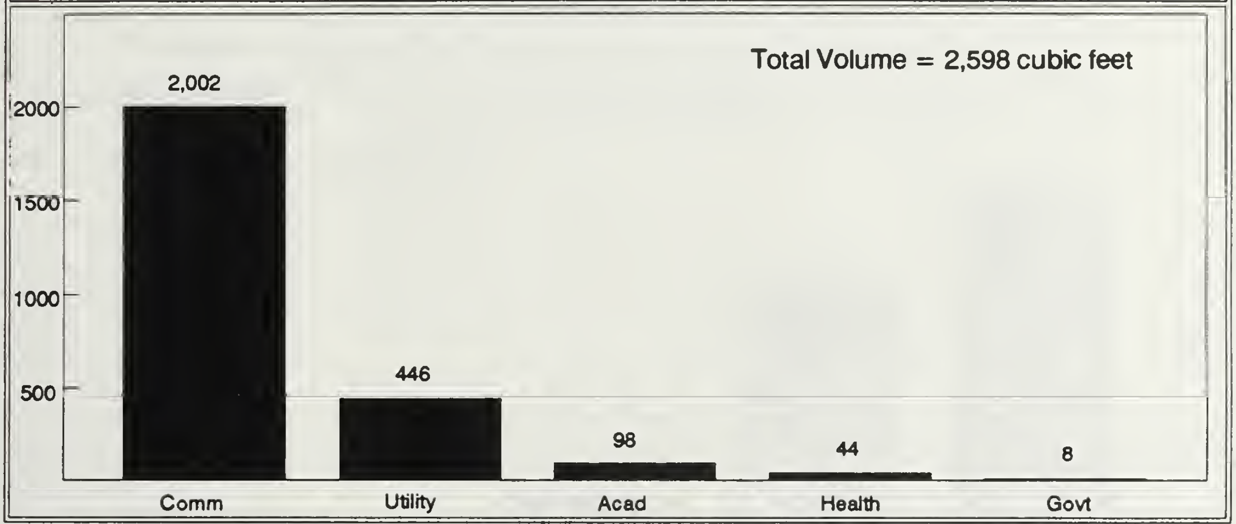
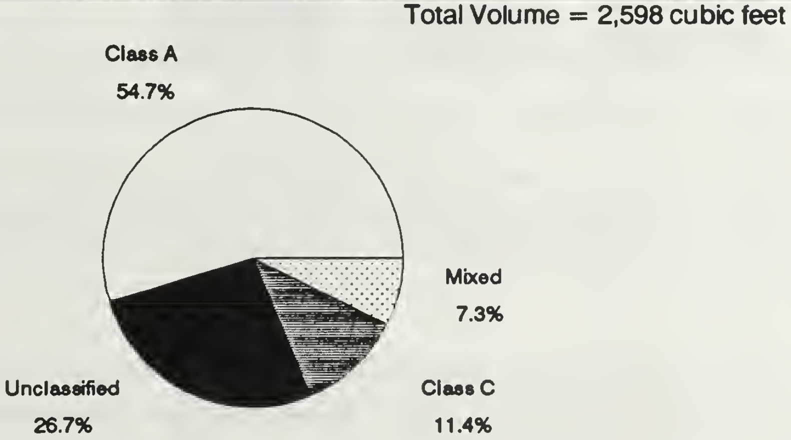


Figure 10

1992 LLRW Volume Placed in Storage for Future Disposal – by Disposal Class

(percent)

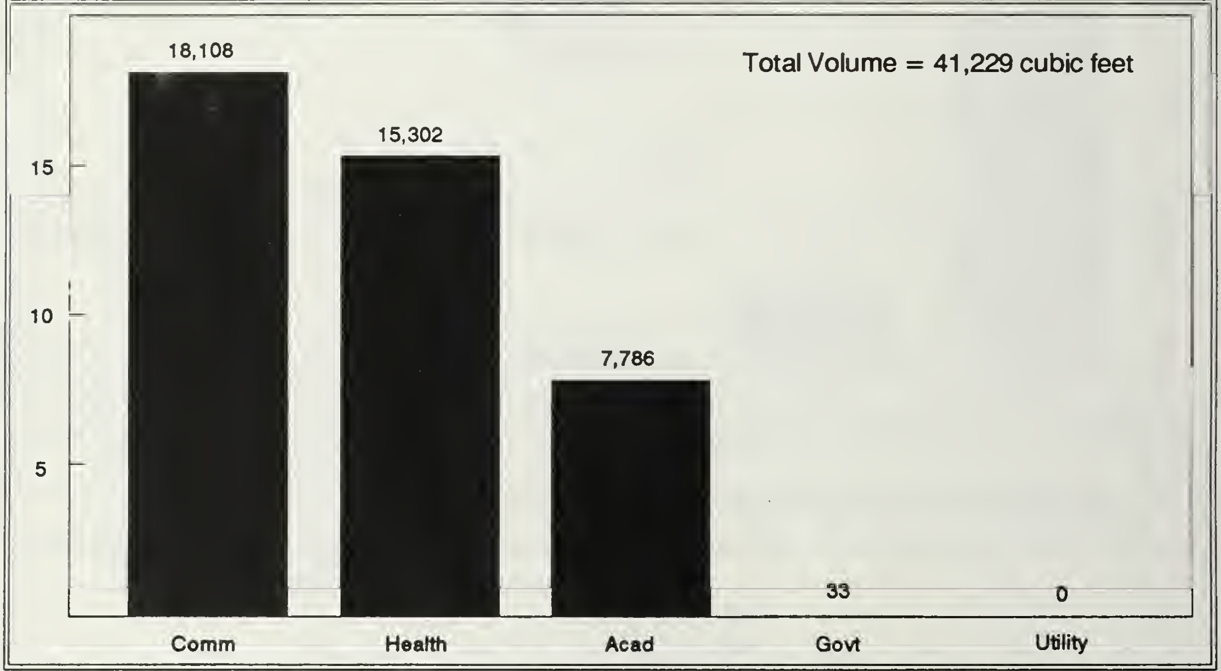


Note: 'Unclassified' waste has not been classified for 'disposal' pursuant to 10 CFR 61.

Storage for Decay Summary

Storage for decay is practical for waste that contains radionuclides with relatively short half–lives. Regulations require waste to be held for at least 10 half–lives prior to disposal. Each NRC license specifies the physical half–life of radionuclides that may be held for decay by the generator. Typically NRC will authorize storage of radionuclides with less than 90 day half–lives. Because many of the radionuclides used by licensees in Massachusetts have half–lives less than 90 days, storage for decay is a common practice. Figure 11 illustrates the volume of LLRW held in storage for decay by each generator category during 1992.

Figure 11
1992 LLRW Volume held in Storage for Decay – by Generator Category
(thousands of cubic feet)



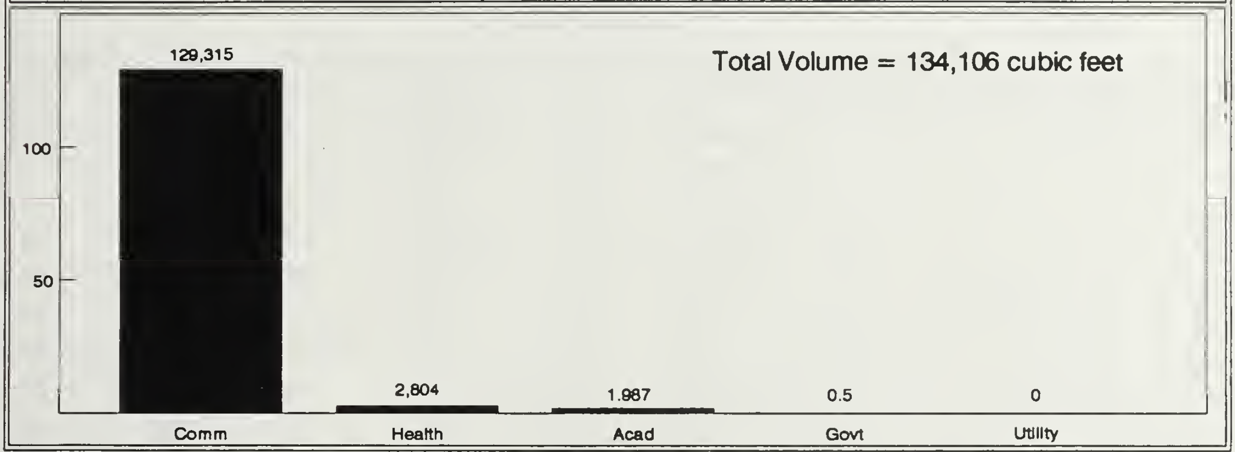
At the conclusion of the storage period, the waste is "monitored" or checked to insure that it is no longer radioactive prior to disposal as ordinary trash or biological hazardous material, depending upon the type of waste. It is common practice for licensees to incinerate waste after the storage for decay period.

Because of the long–lived radionuclides contained within nuclear power wastes and the inability to segregate them from short–lived radionuclides, nuclear power plants do not store LLRW for complete decay.

Other Management Methods Summary

The other management methods category includes waste managed by sewer or atmospheric release, on–site incineration, return to the manufacturer or supplier, and recycle\recovery; 38% of the total LLRW produced during 1992 was managed by a combination of these methods. The largest percentage in this category was released to sanitary sewers. Figure 12 and Table 6 provide a breakdown, by generator category, of LLRW volume managed by these methods. Specific information can be found in Section 4, "Characteristic Data of 1992 Massachusetts LLRW."

Figure 12
1992 LLRW Volume Managed by Other Methods – by Generator Category
(thousands of cubic feet)



It is routine practice for some licensees to release small quantities of radioactive materials to the atmosphere in accordance with NRC regulations. If these radioactive gases were packaged for disposal, they would be considered LLRW. Because they were released to the atmosphere, not all licensees consider them LLRW for reporting purposes; therefore this category may be under reported. For this reason, the above figure shows no waste managed by alternate methods by the utility category.

Table 6
Summary of 1992 LLRW Volume Managed by Other Methods – by Generator Category
(cubic feet)

Management Method	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Incineration	1,646.4	14.9	0.0	1,495.3	0.0	3,156.6	2.4
Return to Manufacturer\Supplier	0.0	291.2	0.5	911.1	0.0	1,202.8	0.9
Recycle\Recover	0.0	155.0	0.0	0.0	0.0	155.0	0.1
Sewerage Release	340.9	126,178.5	0.0	397.3	0.0	126,916.7	94.6
Atmospheric Release[1]	0.0	2,675.0	0.0	0.0	0.0	2,675.0	2.0
Total	1,987.3	129,314.6	0.5	2,803.7	0.0	134,106.1	100.0
% of Total	1.5	96.4	0.0	2.1	0.0	100.0	

[1] Reported

4. Characteristic Data of 1992 Massachusetts LLRW

The following tables present detailed characteristics of LLRW production and management in Massachusetts for 1992.

Production

Production data represents volume and radioactivity before treatment, and include waste placed in storage for future off–site disposal, held in storage for decay, and managed by other methods.

Table 7
1992 LLRW Volume Produced – by Waste and Generator Category
(cubic feet)

Waste Category	Generator Category						% of
	Acad	Comm	Govt	Health	Utility	Total	Total
DAW–Compacted Bulk Material	3,089.3	6,117.2	0.0	388.3	1,977.0	11,571.9	3.3
DAW–Bulk Materials	5,710.8	79,569.0	25,807.2	13,231.3	24,561.1	148,879.3	42.6
DAW–Compacted Solids	0.0	796.0	15.0	0.0	0.0	811.0	0.2
DAW–Solids	376.0	15,462.7	6,085.9	15.0	5,557.0	27,496.6	7.9
DAW–Medical Wastes	301.0	1,341.6	1.0	4,025.0	0.0	5,668.6	1.6
Contaminated Metal Objects	0.0	400.0	0.0	0.0	0.0	400.0	0.1
Dewatered Ion Exchange Media	7.5	18.0	0.0	0.0	3,284.2	3,309.7	0.9
Dewatered Filter Media	0.0	0.0	0.0	0.0	1,029.0	1,029.0	0.3
Other Dewatered Sludges	0.0	2,880.0	0.0	0.0	0.0	2,880.0	0.8
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	92.5	0.0	0.0	0.0	92.5	0.0
Other Solidified Sludges	41.5	0.0	0.0	2.0	0.0	43.5	0.0
Absorbed Liquids	26.0	1,499.0	0.0	149.8	0.0	1,674.9	0.5
Solidified Liquids	37.5	1,359.5	15.0	0.0	3,263.3	4,675.3	1.3
LSF\Vials Organic	1,108.5	1,331.6	0.0	1,309.1	0.0	3,749.2	1.1
LSF\Vials Inorganic	1,137.8	322.0	0.0	80.3	0.0	1,540.1	0.4
Other Organic Liquids	16.5	121.8	0.0	0.0	0.0	138.3	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	15.0	0.0	15.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	9.0	0.0	89.5	0.0	98.5	0.0
Biological Waste or Carcasses	785.5	304.5	3.0	138.8	0.0	1,231.8	0.4
Irradiated Reactor Components	0.0	0.0	0.0	0.0	410.5	410.5	0.1
Other Irradiated Materials	8.0	5.0	0.0	0.0	0.0	13.0	0.0
Gases In Sealed Containers	0.0	8.0	0.0	15.0	0.0	23.0	0.0
Sealed Sources	52.9	393.4	27.1	55.4	0.0	528.8	0.2
Contaminated Oil\Lubricant	0.0	2,717.0	120.0	0.0	240.0	3,077.0	0.9
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	27.0	0.0	0.0	1,109.1	0.0	1,136.1	0.3
Aqueous Liquids	798.7	127,419.6	277.5	402.8	0.0	128,898.6	36.9
Total	13,524.6	242,167.5	32,351.7	21,026.3	40,322.1	349,392.2	100.0

Table 8
1992 LLRW Volume Produced – by Waste Type and Generator Category
(cubic feet)

Waste Type	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Liquids	3,061.5	129,195.0	277.5	1,792.2	0.0	134,326.1	38.4
Wet Solids	7.5	2,898.0	0.0	0.0	4,313.2	7,218.7	2.1
Solids	10,455.6	110,066.5	32,074.2	19,219.1	36,008.9	207,824.3	59.5
Gas	0.0	8.0	0.0	15.0	0.0	23.0	0.0
Total	13,524.6	242,167.5	32,351.7	21,026.3	40,322.1	349,392.2	100.0
% of Total	3.9	69.3	9.3	6.0	11.5	100.0	0.0

Note: Free liquids are not shipped for disposal. The classification as "liquids" refers to the original waste form prior to packaging for disposal. Liquids intended for disposal are immobilized by treatment processes such as absorption or solidification. Wet solids are dewatered to less than 0.5% free liquids or otherwise solidified or packaged with excess absorbents and\or additional packaging materials.

Table 9
1992 LLRW Volume Produced – by Waste Class and Generator Category
(cubic feet)

Waste Class[1]	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
A Unstable	1,425.5	89,533.0	31,856.2	1,626.7	35,448.4	159,889.7	45.8
A Stable	546.5	945.3	454.1	22.5	4,060.5	6,028.9	1.7
B	0.0	104.5	0.0	0.0	132.4	236.9	0.1
C	0.0	134.8	0.0	0.0	235.1	369.9	0.1
GTCC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AU Hazardous	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS Hazardous	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B Hazardous	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C Hazardous	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GTCC Hazardous	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unclassified[2]	11,552.6	151,450.0	41.4	19,377.1	445.7	182,866.8	52.3
Total	13,524.6	242,167.5	32,351.7	21,026.3	40,322.1	349,392.2	100.0
% of Total	3.9	69.3	9.3	6.0	11.5	100.0	0.0

[1] Waste classifications apply only to wastes shipped for disposal.

[2] "Unclassified" category includes all waste not shipped for disposal (i.e. storage for decay, sewer release, etc.).

Table 10
1992 LLRW Radioactivity Produced – by Waste and Generator Category
(curies)

Waste Category	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	15.0533	592.9110	0.0000	0.3014	3.3990	611.6647	0.6
DAW–Bulk Materials	9.0828	340.0872	0.3031	880.1944	5.6306	1,235.2982	1.2
DAW–Compacted Solids	0.0000	0.2971	0.0008	0.0000	0.0000	0.2979	0.0
DAW–Solids	0.0000	548.2575	74.0200	255.4983	2.2462	880.0220	0.9
DAW–Medical Wastes	0.0200	37.6558	0.0000	1,493.1907	0.0000	1,530.8665	1.5
Contaminated Metal Objects	0.0000	0.0009	0.0000	0.0000	0.0000	0.0009	0.0
Dewatered Ion Exchange Media	0.0118	0.2355	0.0000	0.0000	572.6490	572.8963	0.6
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	17.3812	17.3812	0.0
Other Dewatered Sludges	0.0000	1.4015	0.0000	0.0000	0.0000	1.4015	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0014	0.0000	0.0000	0.0000	0.0014	0.0
Other Solidified Sludges	0.0195	0.0000	0.0000	0.0050	0.0000	0.0245	0.0
Absorbed Liquids	0.0226	42,079.3045	0.0000	0.1677	0.0000	42,079.4948	40.7
Solidified Liquids	0.0053	344.3990	0.0032	0.0000	8.4519	352.8594	0.3
LSF\Vials Organic	0.9485	1,890.6252	0.0000	0.2694	0.0000	1,891.8430	1.8
LSF\Vials Inorganic	0.5816	3.0950	0.0000	0.1137	0.0000	3.7903	0.0
Other Organic Liquids	0.3400	344.2312	0.0000	0.0000	0.0000	344.5712	0.3
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0048	0.0000	0.0048	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0006	0.0000	0.0550	0.0000	0.0556	0.0
Biological Waste or Carcasses	2.6752	0.0275	0.0150	2.0242	0.0000	4.7418	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	32,080.0000	32,080.0000	31.0
Other Irradiated Materials	0.0003	0.0297	0.0000	0.0000	0.0000	0.0299	0.0
Gases in Sealed Containers	0.0000	13.7006	0.2170	0.0062	0.0000	13.9238	0.0
Sealed Sources	7.8357	21,536.5344	2.0132	15.9266	0.0000	21,562.3099	20.8
Contaminated Oil\Lubricant	0.0000	2.4958	0.0021	0.0000	0.0192	2.5172	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	10.5000	0.0106	0.0000	206.5077	0.0000	217.0183	0.2
Aqueous Liquids	4.6685	96.2990	0.0041	1.0577	0.0000	102.0293	0.1
Total	51.7652	67,831.6010	76.5785	2,855.3226	32,689.7770	103,505.044	100.0
% of Total	0.1	65.5	0.1	2.8	31.6	100.0	

Treatment

Table 11
1992 LLRW Volume Shipped to Brokers and Processors – by Treatment Method and Generator Category
(cubic feet)

Treatment Method	Generator Category Acad	Comm	Govt	Health	Utility	Total
None	805.7	1,883.8	19.1	406.7	98.4	3,213.6
Compaction up to 250 Tons	1,008.8	1,213.3	0.0	876.4	0.0	3,098.5
Compaction up to 251–999 Tons	0.0	50.6	0.0	350.1	0.0	400.6
Compaction up to 1000–2500 Tons	45.0	205.6	0.0	0.0	0.0	250.6
Compaction above 2500 Tons	75.0	17,968.1	0.0	0.0	28,356.0	46,399.1
Incineration	1,681.3	7,182.6	0.0	1,227.6	90.0	10,181.4
Size Reduction	0.0	5.5	0.0	0.0	0.0	5.5
Wet Oxidation	0.0	0.0	0.0	0.0	0.0	0.0
Solidification	7.5	0.0	277.5	15.0	0.0	300.0
Adsorption	7.5	0.0	0.0	0.0	0.0	7.5
Macroencapsulation	0.0	4.7	0.0	0.0	0.0	4.7
Absorption	22.5	19.0	0.0	0.0	0.0	41.5
Sorting\Segregation	0.0	0.0	0.0	0.0	0.0	0.0
Dry Chemical Packing	0.0	31.4	0.0	0.0	0.0	31.4
Total	3,653.2	28,564.5	296.6	2,875.7	28,544.4	63,934.5

Table 12
1992 LLRW Volume Shipped from Brokers and Processors – by Treatment Method and Generator Category
(cubic feet)

Treatment Method	Generator Category Acad	Comm	Govt	Health	Utility	Total
None	805.7	1,879.8	19.1	406.7	98.4	3,209.6
Compaction up to 250 Tons	379.8	820.4	0.0	450.4	0.0	1,650.7
Compaction up to 251–999 Tons	0.0	12.7	0.0	104.7	0.0	117.4
Compaction up to 1000–2500 Tons	8.1	100.6	0.0	0.0	0.0	108.7
Compaction above 2500 Tons	56.3	3,784.0	0.0	0.0	2,066.3	5,906.5
Incineration	0.0	103.2	0.0	0.0	8.7	111.9
Size Reduction	0.0	1.1	0.0	0.0	0.0	1.1
Wet Oxidation	0.0	0.0	0.0	0.0	0.0	0.0
Solidification	7.5	0.0	277.5	15.0	0.0	300.0
Adsorption	7.5	0.0	0.0	0.0	0.0	7.5
Macroencapsulation	0.0	7.8	0.0	0.0	0.0	7.8
Absorption	11.3	19.0	0.0	0.0	0.0	30.3
Sorting\Segregation	0.0	0.0	0.0	0.0	0.0	0.0
Dry Chemical Packing	0.0	31.4	0.0	0.0	0.0	31.4
Total	1,276.1	6,760.0	296.6	976.8	2,173.4	11,483.0

Table 13
1992 LLRW Treatment Results – by Treatment Method
(cubic feet)

Treatment Method	Shipped to:	Shipped from:	Volume Reduction[1]	Reduction Ratio[2]
Compaction up to 250 Tons	3,098.5	1,650.7	1,447.9	1.9
Compaction up to 251–999 Tons	400.6	117.4	283.2	3.4
Compaction up to 1000–2500 Tons	250.6	108.7	141.9	2.3
Compaction above 2500 Tons	46,399.1	5,906.5	40,492.6	7.9
Incineration	10,181.4	111.9	10,069.5	91.0
Size Reduction	5.5	1.1	4.4	5.0
Wet Oxidation	0.0	0.0	0.0	0.0
Solidification	300.0	300.0	0.0	1.0
Adsorption	7.5	7.5	0.0	1.0
Macroencapsulation	4.7	7.8	N/A	N/A
Absorption	41.5	30.3	11.3	1.4
Sorting\Segregation	0.0	0.0	0.0	0.0
Dry Chemical Packing	31.4	31.4	0.0	1.0
Total	63,934.5	11,483.0	52,451.5	5.6

[1] Volume Reduction = (Volume Shipped to – Volume Shipped from)

[2] Reduction Ratio = (Volume Shipped to / Volume Shipped from)

Table 14

1992 LLRW Volume Shipped to Brokers and Processors – by Waste and Generator Category

(cubic feet)

Waste Category	Generator Category					Total
	Acad	Comm	Govt	Health	Utility	
DAW–Compacted Bulk Material	1,139.8	3,081.7	0.0	388.3	0.0	4,609.9
DAW–Bulk Materials	280.5	7,932.3	0.0	970.7	24,561.1	33,744.6
DAW–Compacted Solids	0.0	796.0	15.0	0.0	0.0	811.0
DAW–Solids	376.0	13,783.1	0.0	0.0	3,840.0	17,999.1
DAW–Medical Wastes	0.0	0.0	0.0	76.8	0.0	76.8
Contaminated Metal Objects	0.0	400.0	0.0	0.0	0.0	400.0
Dewatered Ion Exchange Media	7.5	0.0	0.0	0.0	0.0	7.5
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	41.5	0.0	0.0	0.0	0.0	41.5
Absorbed Liquids	19.5	434.3	0.0	149.8	0.0	603.6
Solidified Liquids	37.5	395.5	0.0	0.0	53.3	486.3
LSF\Vials Organic	1,017.9	930.6	0.0	1,161.6	0.0	3,110.1
LSF\Vials Inorganic	629.3	266.5	0.0	58.7	0.0	954.5
Other Organic Liquids	0.0	15.7	0.0	0.0	0.0	15.7
Incinerator (Incin) Ash	0.0	0.0	0.0	15.0	0.0	15.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	46.0	303.4	0.0	19.0	0.0	368.4
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	8.0	0.0	0.0	0.0	0.0	8.0
Gases in Sealed Containers	0.0	8.0	0.0	0.0	0.0	8.0
Sealed Sources	49.6	74.9	4.1	20.2	0.0	148.9
Contaminated Oil\Lubricant	0.0	105.0	0.0	0.0	90.0	195.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	37.5	277.5	15.5	0.0	330.5
Total	3,653.2	28,564.5	296.6	2,875.7	28,544.4	63,934.5

Table 15
1992 LLRW Volume Shipped from Brokers and Processors – by Waste and Generator Category
(cubic feet)

Waste	Generator Category					
Category	Acad	Comm	Govt	Health	Utility	Total
DAW–Compacted Bulk Material	826.0	2,009.8	0.0	189.1	0.0	3,025.0
DAW–Bulk Materials	232.4	1,301.5	0.0	533.1	1,510.7	3,577.7
DAW–Compacted Solids	0.0	289.3	15.0	0.0	0.0	304.3
DAW–Solids	42.1	2,195.5	0.0	0.0	600.7	2,838.2
DAW–Medical Wastes	0.0	0.0	0.0	42.3	0.0	42.3
Contaminated Metal Objects	0.0	400.0	0.0	0.0	0.0	400.0
Dewatered Ion Exchange Media	7.5	0.0	0.0	0.0	0.0	7.5
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	41.5	0.0	0.0	0.0	0.0	41.5
Absorbed Liquids	15.5	424.2	0.0	142.5	0.0	582.3
Solidified Liquids	7.5	8.5	0.0	0.0	53.3	69.3
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	15.0	0.0	15.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	46.0	43.4	0.0	19.0	0.0	108.4
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	8.0	0.0	0.0	0.0	0.0	8.0
Gases in Sealed Containers	0.0	8.0	0.0	0.0	0.0	8.0
Sealed Sources	49.6	68.3	4.1	20.2	0.0	142.3
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	8.7	8.7
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	11.4	277.5	15.5	0.0	304.4
Total	1,276.1	6,760.0	296.6	976.8	2,173.4	11,483.0

Table 16
1992 LLRW Treatment Results – by Waste Category
(cubic feet)

Waste Category	Shipped to:	Shipped from:	Volume Reduction[1]	Reduction Ratio[2]
DAW–Compacted Bulk Material	4,609.9	3,025.0	1,584.9	1.5
DAW–Bulk Materials	33,744.6	3,577.7	30,166.9	9.4
DAW–Compacted Solids	811.0	304.3	506.7	2.7
DAW–Solids	17,999.1	2,838.2	15,160.8	6.3
DAW–Medical Wastes	76.8	42.3	34.5	1.8
Contaminated Metal Objects	400.0	400.0	0.0	1.0
Dewatered Ion Exchange Media	7.5	7.5	0.0	1.0
Dewatered Filter Media	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0
Other Solidified Sludges	41.5	41.5	0.0	1.0
Absorbed Liquids	603.6	582.3	21.3	1.0
Solidified Liquids	486.3	69.3	417.0	7.0
LSF\Vials Organic	3,110.1	0.0	3,110.1	N/A
LSF\Vials Inorganic	954.5	0.0	954.5	0.0
Other Organic Liquids	15.7	0.0	15.7	0.0
Incinerator (Incin) Ash	15.0	15.0	0.0	1.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	368.4	108.4	260.0	3.4
Irradiated Reactor Components	0.0	0.0	0.0	0.0
Other Irradiated Materials	8.0	8.0	0.0	1.0
Gases in Sealed Containers	8.0	8.0	0.0	1.0
Sealed Sources	148.9	142.3	6.6	1.0
Contaminated Oil\Lubricant	195.0	8.7	186.3	22.4
Gas Filters	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0
Aqueous Liquids	330.5	304.4	26.1	1.1
Total	63,934.5	11,483.0	52,451.5	5.6

[1] Volume Reduction = (Volume Shipped to – Volume Shipped from)

[2] Reduction Ratio = (Volume Shipped to / Volume Shipped from)

Table 17
1992 LLRW Volume Shipped for Disposal – by Waste and Generator Category
(cubic feet)

Waste Category	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	826.0	2,333.0	0.0	189.1	1,977.0	5,325.1	4.5
DAW–Bulk Materials	232.4	59,118.5	25,770.3	534.2	1,510.7	87,166.1	73.2
DAW–Compacted Solids	0.0	289.3	15.0	0.0	0.0	304.3	0.3
DAW–Solids	42.1	3,789.5	6,085.9	0.0	2,317.7	12,235.1	10.3
DAW–Medical Wastes	0.0	0.0	0.0	42.0	0.0	42.0	0.0
Contaminated Metal Objects	0.0	400.0	0.0	0.0	0.0	400.0	0.3
Dewatered Ion Exchange Media	7.5	0.0	0.0	0.0	3,284.2	3,291.7	2.8
Dewatered Filter Media	0.0	0.0	0.0	0.0	1,029.0	1,029.0	0.9
Other Dewatered Sludges	0.0	2,880.0	0.0	0.0	0.0	2,880.0	2.4
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	90.0	0.0	0.0	0.0	90.0	0.1
Other Solidified Sludges	41.5	0.0	0.0	0.0	0.0	41.5	0.0
Absorbed Liquids	15.5	1,219.7	0.0	142.5	0.0	1,377.8	1.2
Solidified Liquids	7.5	387.5	15.0	0.0	3,263.3	3,673.3	3.1
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	15.0	0.0	15.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	46.0	43.4	0.0	19.0	0.0	108.4	0.1
Irradiated Reactor Components	0.0	0.0	0.0	0.0	114.8	114.8	0.1
Other Irradiated Materials	8.0	0.0	0.0	0.0	0.0	8.0	0.0
Gases in Sealed Containers	0.0	8.0	0.0	0.0	0.0	8.0	0.0
Sealed Sources	49.6	79.3	26.6	20.2	0.0	175.8	0.1
Contaminated Oil\Lubricant	0.0	12.0	120.0	0.0	8.7	140.7	0.1
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	284.5	277.5	15.5	0.0	577.5	0.5
Total	1,276.1	70,934.8	32,310.3	977.6	13,505.4	119,004.2	100.0
% of Total	1.1	59.6	27.2	0.8	11.3	100.0	

Table 18

1992 LLRW Volume Shipped for Disposal – by Waste Category and Disposal Class

(cubic feet)

Waste Category	Disposal Classification Class A	Class B	Class C	Total	% of Total
DAW–Compacted Bulk Material	5,325.1	0.0	0.0	5,325.1	4.5
DAW–Bulk Materials	87,166.1	0.0	0.0	87,166.1	73.2
DAW–Compacted Solids	304.3	0.0	0.0	304.3	0.3
DAW–Solids	12,235.1	0.0	0.0	12,235.1	10.3
DAW–Medical Wastes	42.0	0.0	0.0	42.0	0.0
Contaminated Metal Objects	400.0	0.0	0.0	400.0	0.3
Dewatered Ion Exchange Media	3,039.0	132.4	120.3	3,291.7	2.8
Dewatered Filter Media	1,029.0	0.0	0.0	1,029.0	0.9
Other Dewatered Sludges	2,880.0	0.0	0.0	2,880.0	2.4
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	90.0	0.0	0.0	90.0	0.1
Other Solidified Sludges	41.5	0.0	0.0	41.5	0.0
Absorbed Liquids	1,280.3	97.5	0.0	1,377.8	1.2
Solidified Liquids	3,673.3	0.0	0.0	3,673.3	3.1
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	15.0	0.0	0.0	15.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	108.4	0.0	0.0	108.4	0.1
Irradiated Reactor Components	0.0	0.0	114.8	114.8	0.1
Other Irradiated Materials	8.0	0.0	0.0	8.0	0.0
Gases in Sealed Containers	8.0	0.0	0.0	8.0	0.0
Sealed Sources	161.0	7.0	7.8	175.8	0.1
Contaminated Oil\Lubricant	140.7	0.0	0.0	140.7	0.1
Gas Filters	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	450.5	0.0	127.0	577.5	0.5
Total	118,397.4	236.9	369.9	119,004.2	100.0
% of Total	99.5	0.2	0.3	100.0	

Table 19
1992 LLRW Volume Shipped for Disposal – by Waste Type and Generator Category
(cubic feet)

Waste Type	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
Liquids	0.0	284.5	277.5	15.5	0.0	577.5	0.5
Wet Solids	7.5	2,880.0	0.0	0.0	4,313.2	7,200.7	6
Solids	1,268.6	67,762.3	32,032.8	962.0	9,192.2	111,217.9	93.5
Gas	0.0	8.0	0.0	0.0	0.0	8.0	0.0
Total	1,276.1	70,934.8	32,310.3	977.6	13,505.4	119,004.2	100.0
% of Total	1.1	59.6	27.2	0.8	11.3	100.0	

Table 20
1992 LLRW Volume Shipped for Disposal – by Waste Class and Generator Category
(cubic feet)

Generator Catagory	Class A	Class B	Class C	Total	% of Total
Academic	1,276.1	0.0	0.0	1,276.1	0.9
Commercial	70,695.5	104.5	134.8	70,934.8	50.4
Government	32,310.3	0.0	0.0	32,310.3	38.4
Health	977.6	0.0	0.0	977.6	0.7
Utility	13,137.9	132.4	235.1	13,505.4	9.6
Total	118,397.4	236.9	369.9	119,004.2	100.0

Table 21
1992 LLRW Volume and Radioactivity Shipped for Disposal – by Disposal Class
(cubic feet or curies)

Disposal Class	Volume (cu ft)	% of Total	Activity (curies)	% of Total
A Unstable	112,760.6	94.8	1,809.6	2.4
A Stable	5,636.8	4.7	167.7	0.2
B	236.9	0.2	42,229.6	55.3
C	369.9	0.3	32,155.9	42.1
AU Hazardous	0.0	0.0	0.0	0.0
AS Hazardous	0.0	0.0	0.0	0.0
B Hazardous	0.0	0.0	0.0	0.0
C Hazardous	0.0	0.0	0.0	0.0
Total	119,004.2	100.0	76,362.7	100.0

Table 22
1992 LLRW Volume and Radioactivity Shipped for Disposal – by Disposal Facility
(cubic feet or curies)

	Barnwell	Beatty	Hanford	Clive	Total
Volume (cu ft)	48,042.1	7,647.9	2,827.7	60,486.5	119,004.2
% of Total	40.4	6.4	2.4	50.8	100.0
Radioactivity (curies)	32,847.4	43,498.2	14.8	2.4	76,362.7
% of Total	43.0	57.0	0.0	0.0	100.0

Table 23
1992 LLRW Radioactivity Shipped for Disposal – by Waste and Generator Category
(curies)

Waste Category	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
DAW–Compacted Bulk Material	11.4229	417.8600	0.0000	0.3014	3.3990	432.9833	0.6
DAW–Bulk Materials	0.1062	152.9661	0.2900	0.2702	5.6306	159.2631	0.2
DAW–Compacted Solids	0.0000	0.2971	0.0008	0.0000	0.0000	0.2979	0.0
DAW–Solids	0.0000	532.3334	74.0200	0.0000	2.2462	608.5996	0.8
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0033	0.0000	0.0033	0.0
Contaminated Metal Objects	0.0000	0.0009	0.0000	0.0000	0.0000	0.0009	0.0
Dewatered Ion Exchange Media	0.0118	0.0000	0.0000	0.0000	572.6490	572.6608	0.7
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	17.3812	17.3812	0.0
Other Dewatered Sludges	0.0000	1.4015	0.0000	0.0000	0.0000	1.4015	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0014	0.0000	0.0000	0.0000	0.0014	0.0
Other Solidified Sludges	0.0190	0.0000	0.0000	0.0000	0.0000	0.0190	0.0
Absorbed Liquids	0.0216	42,078.4221	0.0000	0.1585	0.0000	42,078.6022	55.1
Solidified Liquids	0.0003	344.1455	0.0032	0.0000	8.4519	352.6009	0.5
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0048	0.0000	0.0048	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0400	0.0187	0.0000	0.0073	0.0000	0.0660	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	32,080.0000	32,080.0000	42.0
Other Irradiated Materials	0.0003	0.0000	0.0000	0.0000	0.0000	0.0003	0.0
Gases in Sealed Containers	0.0000	0.0003	0.0000	0.0000	0.0000	0.0003	0.0
Sealed Sources	0.3155	11.8815	1.9982	6.0608	0.0000	20.2560	0.0
Contaminated Oil\Lubricant	0.0000	2.4955	0.0021	0.0000	0.0000	2.4977	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	36.0444	0.0041	0.0190	0.0000	36.0675	0.0
Total	11.9376	43,577.8683	76.3184	6.8252	32,689.7578	76,362.7074	100.0
% of Total	0.0	57.1	0.1	0.0	42.8	100.0	

Table 24
1992 LLRW Radioactivity Shipped for Disposal – by Waste Category and Disposal Class
(curies)

Waste Category	Disposal Classification Class A	Class B	Class C	Total	% of Total
DAW–Compacted Bulk Material	432.9833	0.0000	0.0000	432.9833	0.6
DAW–Bulk Materials	159.2631	0.0000	0.0000	159.2631	0.2
DAW–Compacted Solids	0.2979	0.0000	0.0000	0.2979	0.0
DAW–Solids	608.5996	0.0000	0.0000	608.5996	0.8
DAW–Medical Wastes	0.0033	0.0000	0.0000	0.0033	0.0
Contaminated Metal Objects	0.0009	0.0000	0.0000	0.0009	0.0
Dewatered Ion Exchange Media	78.2069	443.2559	51.1980	572.6608	0.7
Dewatered Filter Media	17.3812	0.0000	0.0000	17.3812	0.0
Other Dewatered Sludges	1.4015	0.0000	0.0000	1.4015	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0014	0.0000	0.0000	0.0014	0.0
Other Solidified Sludges	0.0190	0.0000	0.0000	0.0190	0.0
Absorbed Liquids	302.7852	41,775.8170	0.0000	42,078.6022	55.1
Solidified Liquids	352.6009	0.0000	0.0000	352.6009	0.5
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	0.0048	0.0000	0.0000	0.0048	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0660	0.0000	0.0000	0.0660	0.0
Irradiated Reactor Components	0.0000	0.0000	32,080.0000	32,080.0000	42.0
Other Irradiated Materials	0.0003	0.0000	0.0000	0.0003	0.0
Gases in Sealed Containers	0.0003	0.0000	0.0000	0.0003	0.0
Sealed Sources	9.7160	10.5100	0.0300	20.2560	0.0
Contaminated Oil\Lubricant	2.4977	0.0000	0.0000	2.4977	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	11.4436	0.0000	24.6239	36.0675	0.0
Total	1,977.2726	42,229.5829	32,155.8519	76,362.7074	100.0
% of Total	2.6	55.3	42.1	100.0	

Table 25

Radioactivity Distribution of 1992 LLRW Shipped for Disposal – by Half–Life and Waste Category

(curies)

Waste Category	Half–life Distribution[1]			Total
	<90 D	90 D– <5 Yrs	5 Yrs or more	
DAW–Compacted Bulk Material	104.0735	3.5940	325.3158	432.9833
DAW–Bulk Materials	20.7085	4.5973	133.9573	159.2631
DAW–Compacted Solids	0.0220	0.0000	0.2759	0.2979
DAW–Solids	309.7696	5.1767	293.6533	608.5996
DAW–Medical Wastes	0.0026	0.0007	0.0001	0.0033
Contaminated Metal Objects	0.0000	0.0000	0.0009	0.0009
Dewatered Ion Exchange Media	57.0020	228.7081	286.9506	572.6608
Dewatered Filter Media	5.3293	6.6460	5.4059	17.3812
Other Dewatered Sludges	0.0000	0.0000	1.4015	1.4015
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000
Cartridge Filters	0.0000	0.0000	0.0014	0.0014
Other Solidified Sludges	0.0000	0.0020	0.0170	0.0190
Absorbed Liquids	235.6649	6.7388	41,836.1984	42,078.6022
Solidified Liquids	0.0036	3.9306	348.6667	352.6009
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000
Incinerator (Incin) Ash	0.0028	0.0020	0.0000	0.0048
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000
Biological Waste or Carcasses	0.0575	0.0010	0.0075	0.0660
Irradiated Reactor Components	0.0000	24,366.0000	7,714.0000	32,080.0000
Other Irradiated Materials	0.0000	0.0000	0.0003	0.0003
Gases in Sealed Containers	0.0000	0.0000	0.0003	0.0003
Sealed Sources	2.1647	0.8360	17.2553	20.2560
Contaminated Oil\Lubricant	0.0150	0.0000	2.4826	2.4977
Gas Filters	0.0000	0.0000	0.0000	0.0000
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000
Aqueous Liquids	5.8913	0.8088	29.3674	36.0675
Total	740.7074	24,627.0419	50,994.9581	76,362.7074
% of Total	12.1	21.1	66.8	

[1] D=Days, Yrs=Years

Table 26

1992 LLRW Radioactivity Shipped for Disposal – by Generator Category and Disposal Class

(curies)

Generator Category	Disposal Classification Class A	Class B	Class C	Total	% of Total
Academic	11.9376	0.0000	0.0000	11.9376	0.0
Commercial	1,766.9174	41,786.2970	24.6539	43,577.8683	57.1
Government	76.2884	0.0300	0.0000	76.3184	0.1
Health	6.8252	0.0000	0.0000	6.8252	0.0
Utility	115.3040	443.2559	32,131.1980	32,689.7578	42.8
Total	1,977.2726	42,229.5829	32,155.8519	76,362.7074	100.0

Table 27

1992 LLRW Radioactivity Shipped for Disposal – by Generator Category and Half-Life

(curies)

Generator Category	Half-life Distribution[1] <180 D	180 D– <5 Yrs	5 Yrs or more	Total
Academic	5.4313	0.1118	6.3946	11.9376
Commercial	672.2165	2.6245	42,903.0273	43,577.8683
Government	0.0000	0.0000	76.3184	76.3184
Health	2.3841	0.0587	4.3824	6.8252
Utility	8,544.2270	16,132.1960	8,013.3349	32,689.7578
Total	9,224.2588	16,134.9909	51,003.4576	76,362.7074

Table 28
Distribution of 1992 LLRW Volume Shipped for Disposal – by Waste Category and Radiation Level
(cubic feet)

Waste	Volume (cubic feet)					
	Radiation Level (millirem/hr)					
Category	Bkgd[1]	<1	1–<10	10–<100	100–<1000	> 1000
DAW–Compacted Bulk Material	1,030.6	1,392.1	220.4	2,417.3	264.8	0.0
DAW–Bulk Materials	27,086.2	58,493.1	121.1	1,465.6	0.0	0.0
DAW–Compacted Solids	11.2	293.1	0.0	0.0	0.0	0.0
DAW–Solids	6,505.3	2,342.7	272.7	3,057.0	57.5	0.0
DAW–Medical Wastes	0.0	7.5	34.5	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	400.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	7.5	0.0	0.0	0.0	0.0	3,284.2
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	1,029.0
Other Dewatered Sludges	0.0	2,880.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	90.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	41.5	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	402.0	307.7	187.5	150.5	330.0	0.0
Solidified Liquids	31.0	432.3	0.0	3,210.0	0.0	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	15.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	108.4	0.0	0.0	0.0	0.0	0.0
Irradiated Rx Components	0.0	0.0	0.0	0.0	0.0	114.8
Other Irradiated Materials	0.0	8.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	8.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	112.4	39.3	23.0	1.0	0.0	0.0
Contaminated Oil\Lubricant	120.0	20.7	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	277.5	202.5	7.5	15.0	15.0	0.0
Total	35,741.7	66,509.1	1,281.7	10,316.4	727.3	4,428.0
% of Total	30.0	55.9	1.1	8.7	0.6	3.7

[1] Bkgd means radiation levels external to the waste container are equivalent to background radiation at the point of generation.

Table 29
Distribution of 1992 Radioactivity Shipped for Disposal – by Waste Category and Radiation Level
(curies)

Waste Category	Radioactivity (curies)					
	Radiation Level (millirem/hour)					
	Bkgd[1]	<1	1–<10	10–<100	100–<1000	> 1000
DAW–Compacted Bulk Material	11.9567	407.7534	0.1470	5.3160	7.8102	0.0000
DAW–Bulk Materials	5.8493	147.7562	0.0288	5.6288	0.0000	0.0000
DAW–Compacted Solids	0.2325	0.0654	0.0000	0.0000	0.0000	0.0000
DAW–Solids	138.6063	460.4866	2.8702	5.5588	1.0777	0.0000
DAW–Medical Wastes	0.0000	0.0008	0.0025	0.0000	0.0000	0.0000
Contaminated Metal Objects	0.0000	0.0000	0.0009	0.0000	0.0000	0.0000
Dewatered Ion Exchange Media	0.0118	0.0000	0.0000	0.0000	0.0000	572.6490
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	17.3812
Other Dewatered Sludges	0.0000	1.4015	0.0000	0.0000	0.0000	0.0000
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cartridge Filters	0.0000	0.0014	0.0000	0.0000	0.0000	0.0000
Other Solidified Sludges	0.0190	0.0000	0.0000	0.0000	0.0000	0.0000
Absorbed Liquids	0.6095	41,877.4872	130.5551	3.7138	66.2366	0.0000
Solidified Liquids	0.0051	344.1468	0.0000	8.4490	0.0000	0.0000
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Incinerator (Incin) Ash	0.0000	0.0000	0.0048	0.0000	0.0000	0.0000
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Biological Waste or Carcasses	0.0660	0.0000	0.0000	0.0000	0.0000	0.0000
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	32,080.0000
Other Irradiated Materials	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000
Gases in Sealed Containers	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000
Sealed Sources	3.4360	16.4168	0.3692	0.0340	0.0000	0.0000
Contaminated Oil\Lubricant	0.0021	2.4955	0.0000	0.0000	0.0000	0.0000
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Aqueous Liquids	0.0041	30.1418	0.0010	2.2080	3.7126	0.0000
Total	160.7987	43,288.1536	133.9794	30.9083	78.8371	32,670.0302
% of Total	0.2	56.7	0.2	0.0	0.1	42.8

[1] Bkgd means radiation levels external to the waste container are equivalent to background radiation at the point of generation.

Storage

Storage data represents waste placed in storage for future off–site disposal. Data in this section does not include waste stored for complete decay.

Table 30
LLRW Volume Placed in Storage During 1992 – by Waste and Generator Category
(cubic feet)

Waste	Generator Category						% of
Category	Acad	Comm	Govt	Health	Utility	Total	Total
DAW–Compacted Bulk Material	29.5	485.8	0.0	0.0	0.0	515.3	19.8
DAW–Bulk Materials	17.0	556.6	7.9	5.0	0.0	586.5	22.6
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	67.3	0.0	0.0	0.0	67.3	2.6
DAW–Medical Wastes	0.0	0.0	0.0	8.0	0.0	8.0	0.3
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	75.7	0.0	0.0	0.0	75.7	2.9
Solidified Liquids	0.0	7.5	0.0	0.0	0.0	7.5	0.3
LSF\Vials Organic	45.0	303.2	0.0	7.5	0.0	355.7	13.7
LSF\Vials Inorganic	0.0	22.5	0.0	7.5	0.0	30.0	1.2
Other Organic Liquids	1.2	0.0	0.0	0.0	0.0	1.2	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	5.0	1.1	0.0	0.0	0.0	6.1	0.2
Irradiated Reactor Components	0.0	0.0	0.0	0.0	295.7	295.7	11.4
Other Irradiated Materials	0.0	0.5	0.0	0.0	0.0	0.5	0.0
Gases in Sealed Containers	0.0	0.0	0.0	15.0	0.0	15.0	0.6
Sealed Sources	0.3	41.3	0.0	[illegible].0	0.0	42.5	1.6
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	150.0	150.0	5.8
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	441.0	0.0	0.0	0.0	441.0	17.0
Total	98.0	2,002.5	7.9	44.0	445.7	2,598.0	100.0
% of Total	3.8	77.1	0.3	1.7	17.2	100.0	

Table 31

LLRW Volume Placed in Storage During 1992 – by Disposal Class and Generator Category

(cubic feet)

Disposal Class	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
Unclassified	2.0	675.0	0.0	16.0	0.0	693.0	26.7
AU	79.8	1,193.8	7.9	27.5	0.0	1,308.9	50.4
AS	0.0	111.2	0.0	0.5	0.0	111.7	4.3
B	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	0.0	0.0	0.0	295.7	295.7	11.4
GTCC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AUH	16.2	11.6	0.0	0.0	150.0	177.8	6.8
ASH	0.0	10.8	0.0	0.0	0.0	10.8	0.4
BH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GTCCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	98.0	2,002.5	7.9	44.0	445.7	2,598.0	100.0
% of Total	3.8	77.1	0.3	1.7	17.2	100.0	

Table 32

LLRW Radioactivity Placed in Storage During 1992 – by Waste and Generator Category

(curies)

Waste Category	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.1720	141.6687	0.0000	0.0000	0.0000	141.8407	0.6
DAW–Bulk Materials	0.0065	14.7496	0.0043	0.0010	0.0000	14.7615	0.1
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	1,213.3526	0.0000	0.0000	0.0000	1,213.3526	5.5
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.4022	0.0000	0.4022	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0013	0.0000	0.0000	0.0000	0.0013	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.0025	638.5071	0.0000	0.0100	0.0000	638.5196	2.9
LSF\Vials Inorganic	0.0000	1.8710	0.0000	0.0100	0.0000	1.8810	0.0
Other Organic Liquids	1.0020	0.0010	0.0000	0.0000	0.0000	1.0030	0.0
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0

Table 32
LLRW Radioactivity Placed in Storage During 1992 – by Waste and Generator Category
(curies)
(continued)

Waste Category	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0010	0.0000	0.0000	0.0000	0.0000	0.0010	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0600	0.0000	0.0000	0.0000	0.0600	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.1500	0.0000	0.1500	0.0
Sealed Sources	0.3000	20,000.4926	0.0000	0.0003	0.0000	20,000.7929	90.9
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.8624	0.0000	0.0000	0.0000	0.8624	0.0
Total	1.4840	22,011.5663	0.0043	0.5735	0.0000	22,013.6281	100.0
% of Total	0.0	100.0	0.0	0.0	0.0	100.0	

Table 33
Total Accumulated LLRW in Storage – by Disposal Class and Generator Category
(cubic feet)

Disposal Class	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Unclassified	39.5	6,129.2	0.0	0.0	445.7	6,614.4	20.9
AU	71.5	16,784.0	30.9	28.0	0.0	16,914.4	53.3
AS	20.5	7,126.9	0.0	0.0	0.0	7,147.4	22.5
B	11.0	0.0	0.0	0.0	0.0	11.0	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GTCC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AUH	22.0	911.5	0.0	0.0	0.0	933.5	2.9
ASH	4.0	97.5	0.0	0.0	0.0	101.5	0.3
BH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GTCCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	168.5	31,049.1	30.9	28.0	445.7	31,722.2	100.0
% of Total	0.5	97.9	0.1	0.1	1.4	100	

Table 34
1992 LLRW Volume Managed by Storage for Decay – by Waste and Generator Category
(cubic feet)

Waste	Generator Category						% of
Category	Acad	Comm	Govt	Health	Utility	Total	Total
DAW–Compacted Bulk Material	1,920.0	2,211.5	0.0	0.0	0.0	4,131.5	10.0
DAW–Bulk Materials	4,747.5	13,247.2	29.0	10,884.9	0.0	28,908.5	70.1
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	18.3	0.0	15.0	0.0	33.3	0.1
DAW–Medical Wastes	301.0	1,156.1	1.0	3,879.7	0.0	5,337.8	12.9
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	13.0	0.0	0.0	0.0	13.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	2.5	0.0	0.0	0.0	2.5	0.0
Other Solidified Sludges	0.0	0.0	0.0	2.0	0.0	2.0	0.0
Absorbed Liquids	0.0	193.6	0.0	0.0	0.0	193.6	0.5
Solidified Liquids	0.0	577.5	0.0	0.0	0.0	577.5	1.4
LSF\Vials Organic	37.6	13.5	0.0	140.0	0.0	191.1	0.5
LSF\Vials Inorganic	7.5	18.0	0.0	0.1	0.0	25.6	0.1
Other Organic Liquids	15.0	106.1	0.0	0.0	0.0	121.1	0.3
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	9.0	0.0	0.0	0.0	9.0	0.0
Biological Waste or Carcasses	250.0	0.0	3.0	77.0	0.0	330.0	0.8
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	4.0	0.0	0.0	0.0	4.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	3.0	8.0	0.0	0.0	0.0	11.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	27.0	0.0	0.0	303.1	0.0	330.1	0.8
Aqueous Liquids	477.6	529.8	0.0	0.0	0.0	1,007.3	2.4
Total	7,786.1	18,108.1	33.0	15,301.8	0.0	41,229.0	100.0
% of Total	18.9	43.9	0.1	37.1	0.0	100.0	

Table 35

1992 LLRW Volume Managed by On-Site Incineration – by Waste and Generator Category

(cubic feet)

Waste Category	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	665.9	14.9	0.0	1,359.0	0.0	2,039.8	64.6
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	500.0	0.0	0.0	4.0	0.0	504.0	16.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	89.5	0.0	89.5	2.8
Biological Waste or Carcasses	480.5	0.0	0.0	42.8	0.0	523.3	16.6
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1,646.4	14.9	0.0	1,495.3	0.0	3,156.6	100.0
% of Total	52.2	0.5	0.0	47.4	0.0	100.0	

Table 36
1992 LLRW Radioactivity Managed by On–Site Incineration – by Waste and Generator Category
(curies)

Waste Category	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Bulk Materials	0.5039	0.0108	0.0000	0.5015	0.0000	1.0163	29.9
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.1000	0.0000	0.0000	0.1023	0.0000	0.2023	6.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0560	0.0000	0.0560	1.6
Biological Waste or Carcasses	0.1214	0.0000	0.0000	2.0009	0.0000	2.1223	62.5
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.7253	0.0108	0.0000	2.6607	0.0000	3.3968	100.0
% of Total	21.4	0.3	0.0	78.3	0.0	100.0	

Table 37

1992 LLRW Volume and Radioactivity Released to Sewerage Systems – by Generator Category

(cubic feet and curies)

Generator Category	Volume (cu ft)	% of Total	Activity (curies)	% of Total
Academic	340.9	0.3	0.8719	21.3
Commercial	126,178.5	99.4	2.1141	51.7
Government	0.0	0.0	0.0075	0.2
Health	397.3	0.3	1.0950	26.8
Utility	0.0	0.0	0.0000	0.0
Total	126,916.7	100.0	4.0885	100.0

Table 38

1992 LLRW Volume and Radioactivity of Atmospheric[1] Releases – by Generator Category

(cubic feet and curies)

Generator Category	Volume (cu ft)	% of Total	Activity (curies)	% of Total
Academic	0.0	0.0	0.0000	0.0
Commercial	2,675.0	100.0	13.7000	100.0
Government	0.0	0.0	0.0000	0.0
Health	0.0	0.0	0.0000	0.0
Utility	0.0	0.0	0.0000	0.0
Total	2,675.0	100.0	13.7000	100.0

[1] Reported

5. 1992 LLRW Mixed Waste Information

Production and Disposition Summary

Massachusetts radioactive materials users reported producing 3,929.5 cubic feet of mixed waste in 1992. This subset of the LLRW stream is comprised of radioactively contaminated waste that is mixed with, or otherwise exhibits the characteristics of "hazardous" waste. In 1992:

- 3,037 cubic feet (77%) was eliminated by treatment;
- 502 cubic feet (13%) was placed in storage; and
- 381 cubic feet was placed in storage for decay.

Although this waste was included in the LLRW data previously presented, it is separated here for clarity.

Table 39
Summary of 1992 Mixed Waste Production and Disposition
(cubic feet)

	Generator Category						% of
Production\Disposition	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**Total**
Produced	1,108.2	1,666.4	0.0	1,004.8	150.0	3,929.5	100.0
Management Method							
Placed in Storage	45.2	291.9	0.0	15.0	150.0	502.1	12.8
Store for Decay	15.1	365.3	0.0	0.1	0.0	380.5	9.7
Incineration (in State)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Return to Manufacturer\Supplier	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycle\Recover	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sewage Disposal	0.0	0.0	0.0	10.0	0.0	10.0	0.3
Atmospheric Release	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	60.3	657.2	0.0	25.1	150.0	892.6	22.7
Broker\Processor Treatment							
Shipped to:	1,047.9	1,009.2	0.0	979.7	0.0	3,036.9	N/A
Shipped from:	0.0	0.0	0.0	0.0	0.0	0.0	N/A
Volume Eliminated	1,047.9	1,009.2	0.0	979.7	0.0	3,036.9	77.3
Shipped for Disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Production

Table 40 lists the waste categories which comprise the 1992 Massachusetts mixed waste stream. Liquid scintillation fluids accounted for the majority of mixed waste produced during 1992, totaling 2,957 cubic feet (75%).

Table 40
1992 Mixed Waste Volume Produced – by Waste and Generator Category
(cubic feet)

Waste Category	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Still bottoms	0.0	15.0	0.0	0.0	0.0	15.0	0.4
Contaminated oil	0.0	0.0	0.0	0.0	150.0	150.0	3.8
Pesticides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HPLC solvents	0.0	0.8	0.0	0.0	0.0	0.8	0.0
Nonane with tribute phosphate	0.0	4.1	0.0	0.0	0.0	4.1	0.1
Acetone\Ethanol	0.0	7.5	0.0	0.0	0.0	7.5	0.2
Phenol	15.2	0.0	0.0	0.0	0.0	15.2	0.4
Liquid scintillation fluid\vials inorganic	0.0	0.0	0.0	25.1	0.0	25.1	0.6
Liquid scintillation fluid\vials organic	1,063.0	889.5	0.0	979.7	0.0	2,932.2	74.6
Solidified liquids	30.0	747.0	0.0	0.0	0.0	777.0	19.8
Absorbed liquids	0.0	1.1	0.0	0.0	0.0	1.1	0.0
DAW–Uncompacted solids	0.0	1.4	0.0	0.0	0.0	1.4	0.0
DAW–Uncompacted bulk materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1,108.2	1,666.4	0.0	1,004.8	150.0	3,929.5	100.0

Table 41
1992 Mixed Waste Radioactivity Produced – by Waste and Generator Category
(curies)

Waste Category	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Still bottoms	0.0000	0.0013	0.0000	0.0000	0.0000	0.0013	0.0
Contaminated oil	0.0000	0.0000	0.0000	0.0000	0.0192	0.0192	0.0
Pesticides	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
HPLC solvents	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Nonane with tribute phosphate	0.0000	0.0002	0.0000	0.0000	0.0000	0.0002	0.0
Acetone\Ethanol	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Phenol	0.3000	0.0000	0.0000	0.0000	0.0000	0.3000	0.0
Liquid scintillation fluid\vials inorganic	0.0010	0.0000	0.0000	0.0003	0.0000	0.0013	0.0
Liquid scintillation fluid\vials organic	0.9188	1,890.4509	0.0000	0.1578	0.0000	1,891.5275	99.9
Solidified liquids	0.0050	0.0644	0.0000	0.0000	0.0000	0.0694	0.0
Absorbed liquids	0.0000	0.7400	0.0000	0.0000	0.0000	0.7400	0.0
DAW–Uncompacted solids	0.0000	0.0060	0.0000	0.0000	0.0000	0.0060	0.0
DAW–Uncompacted bulk materials	0.0000	0.0474	0.0000	0.0000	0.0000	0.0474	0.0
Total	1.2248	1,891.3102	0.0000	0.1581	0.0192	1,892.7123	100.0

Treatment

Treatment data represents waste shipped off–site to brokers and processors.

Table 42
1992 Mixed Waste Volume Shipped to Processors – by Treatment Method and Generator Category

(cubic feet)

Treatment	Generator Category					
Method	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**
Incineration	1,047.9	1,009.2	0.0	979.7	0.0	3,036.9
Total	1,047.9	1,009.2	0.0	979.7	0.0	3,036.9

Note: Incineration was the only reported treatment method.

Table 43
1992 Mixed Waste Treatment Results – by Treatment Method

(cubic feet)

Treatment Method	Shipped to:	Shipped from:	Volume Reduction[1]	Reduction Ratio[2]
Incineration	3,036.9	0.0	3,036.9	N/A
Total	3,036.9	0.0	3,036.9	N/A

[1] Volume Reduction = (Volume Shipped to – Volume Shipped from)

[2] Reduction Ratio = (Volume Shipped to / Volume Shipped from)

Table 44
1992 Mixed Waste Volume Shipped to Processors – by Waste and Generator Category

(cubic feet)

Waste	Generator Category					
Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**
Still bottoms	0.0	15.0	0.0	0.0	0.0	15.0
Contaminated oil	0.0	0.0	0.0	0.0	0.0	0.0
Pesticides	0.0	0.0	0.0	0.0	0.0	0.0
HPLC solvents	0.0	0.0	0.0	0.0	0.0	0.0
Nonane with tribute phosphate	0.0	4.1	0.0	0.0	0.0	4.1
Acetone\Ethanol	0.0	7.5	0.0	0.0	0.0	7.5
Phenol	0.0	0.0	0.0	0.0	0.0	0.0
Liquid scintillation fluid\vials inorganic	0.0	0.0	0.0	7.5	0.0	7.5
Liquid scintillation fluid\vials organic	1,017.9	603.1	0.0	972.2	0.0	2,593.3
Solidified liquids	30.0	379.5	0.0	0.0	0.0	409.5
Absorbed liquids	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Uncompacted solids	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Uncompacted bulk materials	0.0	0.0	0.0	0.0	0.0	0.0
Total	1,047.9	1,009.2	0.0	979.7	0.0	3,036.9

Table 45
1992 Mixed Waste Treatment Results – by Waste Category
(cubic feet)

Waste Category	Shipped to:	Shipped from:	Volume Reduction[1]	Reduction Ratio[2]
Still bottoms	15.0	0.0	15.0	N/A
Contaminated oil	0.0	0.0	0.0	N/A
Pesticides	0.0	0.0	0.0	N/A
HPLC solvents	0.0	0.0	0.0	N/A
Nonane with tribute phosphate	4.1	0.0	4.1	N/A
Acetone\Ethanol	7.5	0.0	7.5	N/A
Phenol	0.0	0.0	0.0	N/A
Liquid scintillation fluid\vials inorganic	7.5	0.0	7.5	N/A
Liquid scintillation fluid\vials organic	2,593.3	0.0	2,593.3	N/A
Solidified liquids	409.5	0.0	409.5	N/A
Absorbed liquids	0.0	0.0	0.0	N/A
DAW–Uncompacted solids	0.0	0.0	0.0	N/A
Total	3,036.9	0.0	3,036.9	N/A

[1] Volume Reduction = (Volume Shipped to – Volume Shipped from)

[2] Reduction Ratio = (Volume Shipped to / Volume Shipped from)

Other Management Methods

"Other" management methods refers to disposal practices performed at the point of generation. A description of these practices can be found in Section 2 of this report.

Table 46
1992 Mixed Waste Volume Managed by Storage for Decay – by Waste and Generator Category
(cubic feet)

Waste Category	Generator Category						% of
	Acad	Comm	Govt	Health	Utility	Total	Total
Still bottoms	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pesticides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HPLC solvents	0.0	0.8	0.0	0.0	0.0	0.8	0.2
Nonane with tribute phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acetone\Ethanol	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phenol	15.0	0.0	0.0	0.0	0.0	15.0	3.9
Liquid scintillation fluid\vials inorganic	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Liquid scintillation fluid\vials organic	0.1	2.0	0.0	0.0	0.0	2.1	0.5
Solidified liquids	0.0	360.0	0.0	0.0	0.0	360.0	94.6
Absorbed liquids	0.0	1.1	0.0	0.0	0.0	1.1	0.3
DAW–Uncompacted solids	0.0	1.4	0.0	0.0	0.0	1.4	0.[illegible]
DAW–Uncompacted bulk materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	15.1	365.3	0.0	0.1	0.0	380.5	100.0
% of Total	4.0	96.0	0.0	0.0	0.0	100.0	

Table 47
1992 Mixed Waste Volume Managed by Other Methods – by Generator Category
(cubic feet)

Management Method	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Store for Decay	15.1	365.3	0.0	0.1	0.0	380.5	97.4
Incineration	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Return To Manuf.\Supplier	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycle\Recover	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sewerage	0.0	0.0	0.0	10.0	0.0	10.0	2.6
Atmospheric Release	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	15.1	365.3	0.0	10.1	0.0	390.5	100.0
% of Total	3.9	93.5	0.0	2.6	0.0		

Storage

Storage data represents waste placed in storage for future off–site disposal. Waste may be placed in storage for several reasons, including consolidation for shipment, a real or perceived lack of treatment capacity, or partial decay before shipment. Data in this section does not include waste stored for complete decay.

Table 48
Mixed Waste Volume Placed in Storage During 1992 – by Waste and Generator Category
(cubic feet)

Waste Category	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Still bottoms	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated oil	0.0	0.0	0.0	0.0	150.0	150.0	29.9
Pesticides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HPLC solvents	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane with tribute phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acetone\Ethanol	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phenol	0.2	0.0	0.0	0.0	0.0	0.2	0.0
Liquid scintillation fluid\vials inorganic	0.0	0.0	0.0	7.5	0.0	7.5	1.5
Liquid scintillation fluid\vials organic	45.0	284.4	0.0	7.5	0.0	336.9	67.1
Solidified liquids	0.0	7.5	0.0	0.0	0.0	7.5	1.5
Absorbed liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Uncompacted solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Uncompacted bulk materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	45.2	291.9	0.0	15.0	150.0	502.1	100.0
% of Total	9.0	58.1	0.0	3.0	29.9		

Table 49
Mixed Waste Volume Placed in Storage During 1992
—by Disposal Class and Generator Category
(cubic feet)

Disposal Class	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
Unclassified	0.0	270.0	0.0	0.0	0.0	270.0	53.8
GTCC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AUH	45.2	13.0	0.0	15.0	150.0	223.2	44.5
ASH	0.0	8.8	0.0	0.0	0.0	8.8	1.8
BH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GTCCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	45.2	291.9	0.0	15.0	150.0	502.1	100.0
% of Total	9.0	58.1	0.0	3.0	29.9	100	

Table 50
Mixed Waste Radioactivity Placed in Storage During 1992
– by Waste and Generator Category
(curies)

Waste Category	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
Still bottoms	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated oil	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Pesticides	0.0000	0.0010	0.0000	0.0000	0.0000	0.0010	0.0
HPLC solvents	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Nonane with tribute phosphate	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Acetone\Ethanol	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Phenol	0.0020	0.0000	0.0000	0.0000	0.0000	0.0020	0.0
Liquid scintillation fluid\vials inorganic	0.0000	0.0000	0.0000	0.0100	0.0000	0.0100	0.0
Liquid scintillation fluid\vials organic	0.0025	638.4966	0.0000	0.0100	0.0000	638.5091	100.0
Solidified liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Uncompacted solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Uncompacted bulk materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.0045	638.4976	0.0000	0.0200	0.0000	638.5221	100.0
% of Total	0.0	100.0	0.0	0.0	0.0		

Table 51
Total Accumulated Mixed Waste in Storage – by Disposal Class and Generator Category

(cubic feet)

Disposal Class	Generator Category					Total	% of Total
	Acad	Comm	Govt	Health	Utility		
Unclassified	15.0	4,321.3	0.0	0.0	150.0	4,486.3	24.9
AUH	59.5	13,378.0	0.0	15.0	0.0	13,452.5	74.6
ASH	0.0	97.5	0.0	0.0	0.0	97.5	0.5
BH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GTCCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	74.5	17,796.9	0.0	15.0	150.0	18,036.4	100.0
% of Total	0.4	98.7	0.0	0.1	0.8	100	

6. 1992 LLRW Shipment Information

The following two tables provide information on LLRW shipments as reported by generators transporting LLRW for disposal during 1992. Shipments shown in Tables 52 and 53 are segregated by three types, based on U.S. Department of Transportation (DOT) and NRC regulations: LSA or strong tight, Type A, and Type B. "LSA" or Low Specific Activity refers to packages containing low average concentrations of radioactivity, uniformly distributed. Type A and B package designations bear no correlation to NRC Class A and B disposal classifications.

Table 52

1992 LLRW Shipments – by Shipment Type and Generator Category

(number of shipments)

Type of Shipment	Generator Category Acad	Comm	Govt	Health	Utility	Total
LSA	17	145	76	40	48	326
Type A	66	150	1	63	0	280
Type B	0	3	0	0	3	6
Total	83	298	77	103	51	612

Table 53

1992 LLRW Shipment Destination – by Generator Category

(number of shipments)

Generator Category	Return to Supplier	via Broker \Processor	Directly to Disposal	Total
Academic	0	77	6	83
Commercial	4	225	69	298
Government	0	77	0	77
Health	2	101	0	103
Utility	0	13	38	51
Total	6	493	113	612

LSA or "strong tight" packaging is designed to withstand normal transportation conditions. The limits on radioactive material quantities in an LSA package are such that any risks would be minimal if the material were dispersed during an accident. Type A packages are designed to withstand a higher level of stress (including rough handling); limits on radioactivity in these packages are such that there would not be significant effects on persons or the environment if the contents were dispersed during an accident. Type B packages are designed to withstand stress associated with an accident condition since the quantities of radioactive materials allowed would have a greater potential hazard than Type A materials.[6]

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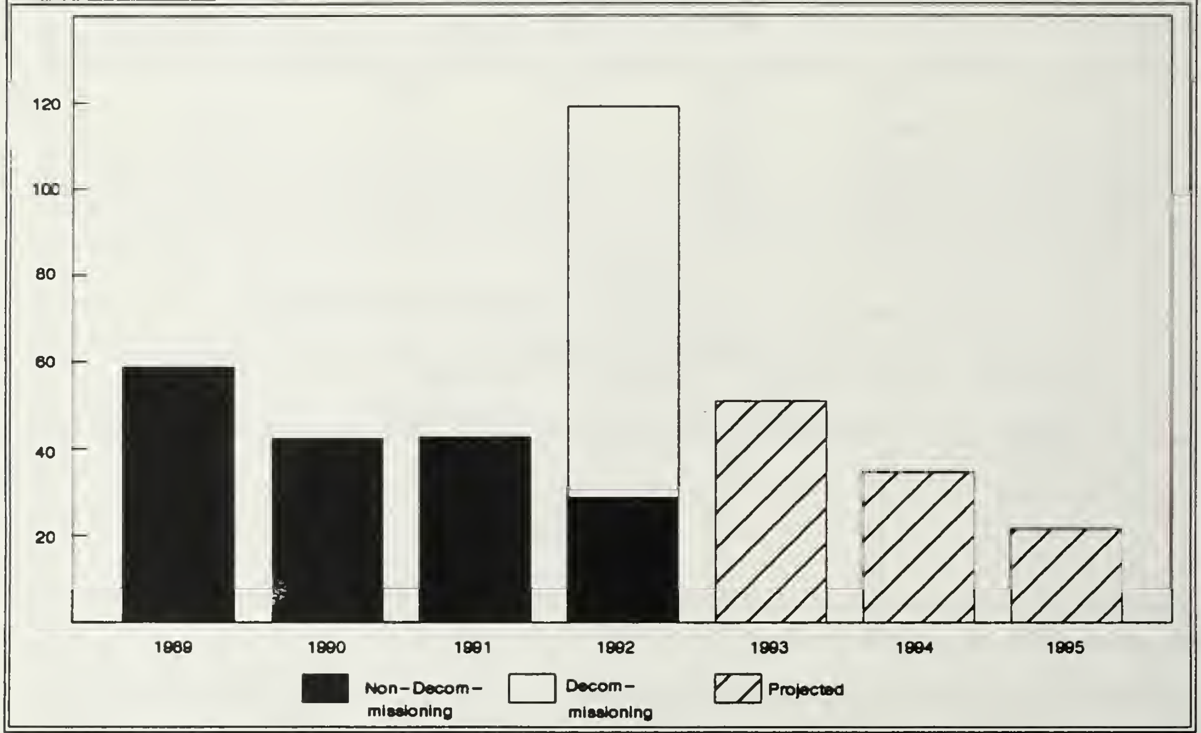
[6] Federal Emergency Management Agency. Guidance for Developing State, Tribal, and Local Radiological Emergency Response Planning and Preparedness for Transportation Accidents. FEMA–REP–5, Revision 1. Washington DC: June, 1992.

7. Evaluating the 1992 Data for Policy–Making Purposes

The volume of LLRW shipped for disposal increased by 279% in 1992. This increase is due to growth of the decommissioning waste stream, which accounted for approximately three quarters (91,000 cubic feet) of LLRW shipped for disposal during 1992. One quarter, or approximately 28,000 cubic feet, can be attributed to "normal" shippable waste production. Figure 13 illustrates how 1992 volume shipped for disposal compares with previous years and future projections as reported by LLRW generators.

Figure 13
Historical and Projected LLRW Volume Shipped for Disposal
(thousands of cubic feet)



Of the three NRC disposal classes, Class A waste continues to account for the largest percentage shipped for disposal; for 1992, the waste class breakdown is: 99.5% Class A, 0.2% Class B, and 0.3% Class C.

The radioactivity of LLRW shipped for disposal increased by 135%, in 1992 due to a shipment of irradiated hardware from the Yankee Rowe power reactor.

Of the three NRC disposal classes, Class B waste continues to account for the largest percentage of radioactivity shipped for disposal; for 1992, the waste class breakdown is: 2.6% Class A, 55.3% Class B, and 42.1% Class C.

Radioactive Characteristics of Massachusetts LLRW Shipped for Disposal

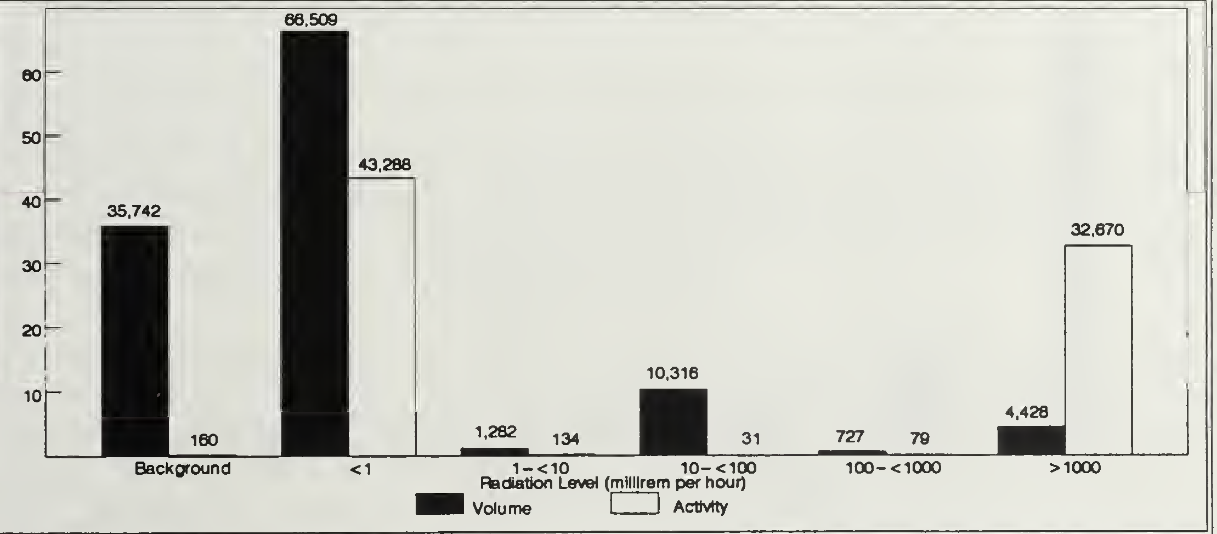
Figure 14 below presents the distribution of radiation levels, measured external to the waste container, of 1992 LLRW volume and radioactivity shipped for disposal.

The majority of LLRW volume shipped for disposal, over 85%, emits radiation between a level indistinguishable from background and 1 millirem per hour. Background radiation, which naturally varies from location to location, is defined as the radiation level at a site exclusive of radiation from licensee activities. Natural background radiation in the Boston area (not including indoor radon) is about 65 millirem per year. For comparison, according to the U.S. Environmental Protection Agency, the average annual dose to an individual from both natural and man–made sources is 360 millirem per year.

The figure illustrates the fact that there is not always a direct relationship between quantity of radioactivity and radiation level emitted. Rather, radiation levels depend upon the type of nuclide. For example, a shipment of Class B waste (represented in the second set of bars near the left of the figure) containing over 40,000 curies of tritium, emits radiation at a level of below 1 millirem an hour; this is because tritium emits a "low energy" particle unable to penetrate the waste container.

The last set of bars, at the right side of the graph, includes a Class C shipment of irradiated hardware from Yankee Rowe that emits radiation at a level of 4000 rem an hour. This waste includes several nuclides (including Silver–110, and Cobalt–60) that emit high energy gamma rays which easily pass through the waste container. However these high energy emitters will decay to essentially background levels in less than 100 years.

Figure 14
Distribution of Volume and Radioactivity of 1992 LLRW Shipped for Disposal – by Radiation Level
(thousands of cubic feet and curies)



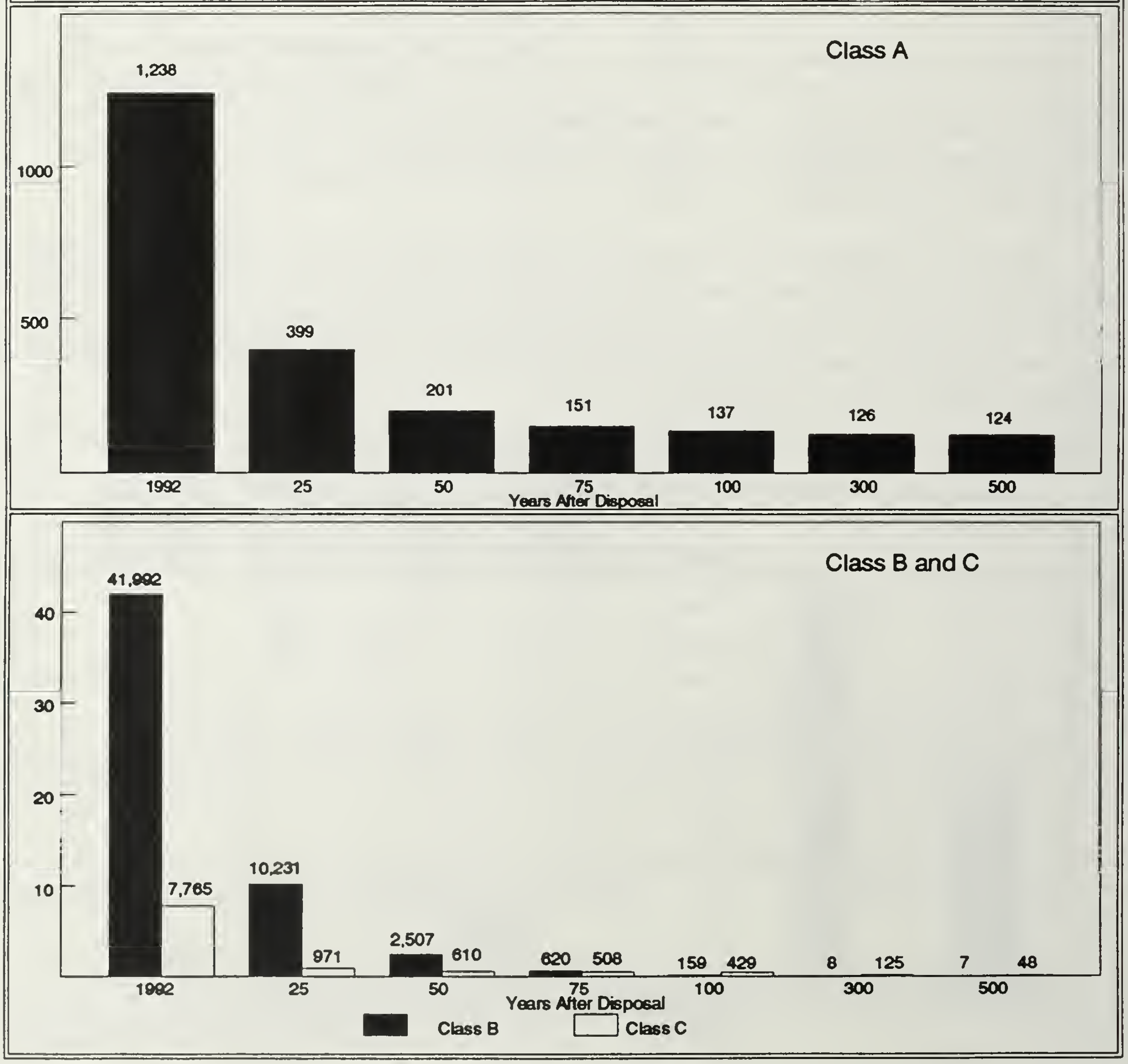
Impact of Radioactive Decay over Time

Figures 15 and 16 illustrate how radioactivity in LLRW shipped for disposal will decrease in time due to natural decay. The data indicates that the combination of radionuclides within the waste will experience substantial decay over the life of a disposal facility. Radioactivity, as used in these figures, is the number of curies contributed by radionuclides with half–lives greater than five years (nuclides with smaller half–lives will decay in a much shorter period than the time frame shown on the graph). For clarity, Class A waste is graphed separately from B and C because of large differences in the magnitudes of radioactivity.

Figure 15

Decay of 1992 Class A, B and C LLRW Radioactivity Shipped for Disposal

(curies)



At the time of disposal, Class A waste contained the least number of curies, but after 500 years, it will contain the most. This is because radionuclides contributing the largest amounts of radioactivity, in Massachusetts Class B and C wastes, have half-lives that allow them to experience significant decay within 500 years. It is interesting to note that one of the largest contributors to radioactivity remaining in all waste classes is Carbon-14 (40%), a radionuclide produced naturally in the atmosphere. See Table 55 for a listing of radionuclides remaining 100 and 500 years after disposal.

Figure 16 shows the percentage of radioactivity remaining within each disposal class and the amount contributed by each waste category. The data indicates that after 500 years, 69% of the activity will be contained in Class A, 27% in Class C, and the remaining 4% in Class B. The majority contribution of 43% is from the commercial category; the second largest contribution of 42% is from the government category, followed by 14% from the utility category, with the remaining 1% from the academic, government and health categories, combined.

Figure 16

Percentage of Radioactivity after 500 Years in 1992 LLRW Shipped for Disposal – by Disposal Class and Generator Category

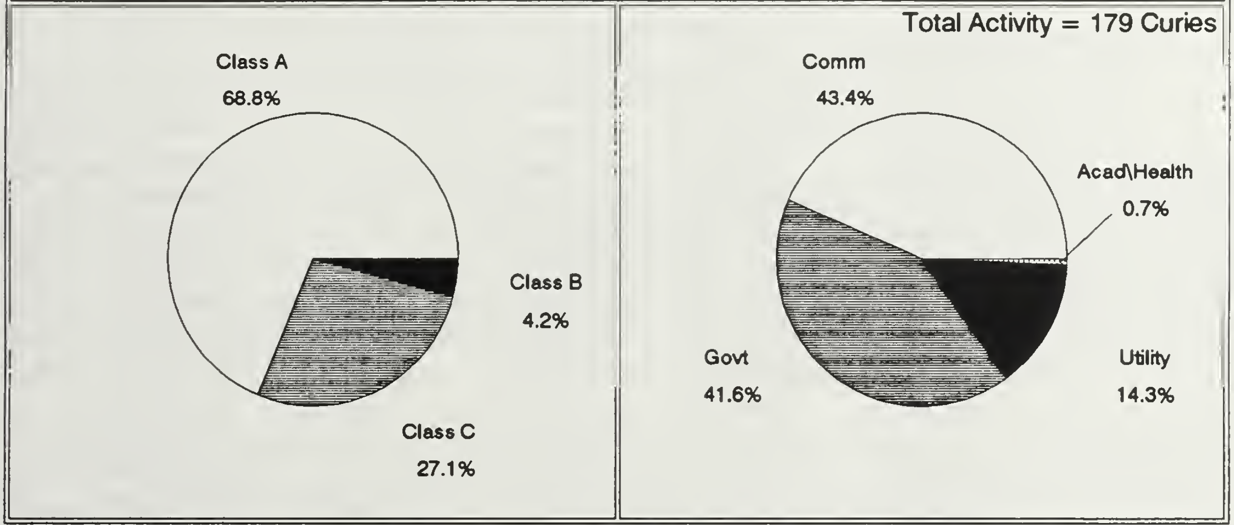


Table 54 shows the percentage of radioactivity remaining over time in the 1992 LLRW shipped for disposal. After 100 and 500 years, 1.4% and 0.4% respectively, will remain (of radionuclides with greater than 5 year half-lives). Because of the extremely long half-lives of the residual radionuclides, the remaining radioactivity will not change much after 500 years.

Table 55 provides a breakdown of radionulides, and their associated activities, 100 and 500 years after disposal. It also lists the generator category contributing the largest quantity of that nuclide to the waste stream. See Appendix B for a breakdown of radionuclides by generator category. Uranium-238 (44%), Carbon-14 (40%), and Nickel-63 (14%) are the largest contributors, totaling over 99% of the radioactivity remaining.

Table 54
Decay of 1992 LLRW Radioactivity[1] Shipped for Disposal – by Waste Class
(percent of initial radioactivity)

Disposal Class	Initial Radioactivity	Years after Disposal 25	50	75	100	300	500
Class A	1238.43	32.3	16.3	12.2	11.0	10.2	10.0
Class B	41,991.99	24.4	6.0	1.5	0.4	0.0	0.0
Class C	7,764.74	12.5	7.9	6.5	5.5	1.6	0.6
Total Shipped	50,995.16	22.7	6.5	2.5	1.4	0.5	0.4

[1] Nuclides with greater than 5 year half–lives

The largest contributor to radioactivity remaining is Uranium–238 (44.4%). Uranium is naturally occuring in the earth's crust and can be found in soil, rock, and seawater. The second largest contributor is Carbon–14. Carbon–14, produced in the atmosphere by the interaction of cosmic rays and nitrogen in the air (a process which produces thousands of curies per year), is one of several radionuclides that naturally occur in the human body; other nuclides include Potassium–40, and Radium–226. The total content of radioactive materials in the body is about 0.000000102 curies.[7]

Table 55
Radionuclides Remaining in 1992 LLRW Shipped for Disposal after 100 and 500 Years
(curies)

Radionuclide	Half–life (years)	100 Years After Disposal	500 Years After Disposal	% of Total at 500 Years	Major Contributor
U–238	4,500,000,000	79.43489081	79.43488592	44.4	Government
C–14	5,730	76.00398271	72.41391712	40.5	Commercial
Ni–63	100	409.8595103	25.61621939	14.3	Utility
Ra–226	1,600	0.733409201	0.616721168	0.3	Academic
Tc–99	213,000	0.368145358	0.367666461	0.2	Academic
U–234	246,000	0.295646685	0.295313658	0.2	Commercial
Cl–36	301,000	0.033680743	0.033649733	0.0	Commercial
Am–241	433	0.047472974	0.025013006	0.0	Academic
Th–232	14,000,000,000	0.020683400	0.020683399	0.0	Commercial
U–235	704,000,000	0.019999998	0.019999990	0.0	Commercial
Th–230	75,400	0.010989892	0.010949555	0.0	Commercial
I–129	15,700,000	0.003114786	0.003114731	0.0	Commercial
Pu–239/40	6,560	0.001576951	0.001511690	0.0	Commercial
Ni–59	76,000	0.000623034	0.000620765	0.0	Utility
Cs–137	30.2	4.005821122	0.000408843	0.0	Utility
Pu–238	87.7	0.000624538	0.000026458	0.0	Commercial
U–236	23,000,000	0.000018030	0.000018030	0.0	Utility
Sr–90	29.1	0.219783110	0.000015993	0.0	Utility
H–3	12.3	152.665272340	0.000000025	0.0	Commercial

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[7] Shapiro, J. Radiation Protection: A Guide for Scientists and Physicians. Harvard University Press, Cambridge, MA, 1972.

Table 55
Radionuclides Remaining in 1992 LLRW Shipped for Disposal after 100 and 500 Years
(curies)
(continued)

Radionuclide	Half-life (years)	100 Years After Disposal	500 Years After Disposal	% of Total at 500 Years	Major Contributor
Pb-210	22.3	0.000223442	0.000000001	0.0	Commercial
Bi-207	32.2	0.000002149	0.000000000	0.0	Commercial
Cm-234/44	17.3	0.000065004	0.000000000	0.0	Academic
Pu-241	14.4	0.001414400	0.000000000	0.0	Commercial
Kr-85	10.7	0.062614241	0.000000000	0.0	Academic
Eu-152	13.5	0.000000872	0.000000000	0.0	Utility
Ba-133	10.5	0.000153376	0.000000000	0.0	Commercial
Eu-154	8.6	0.000000004	0.000000000	0.0	Commercial
Co-60	5.3	0.013845694	0.000000000	0.0	Utility
Total		723.8035652	178.8607359	100.0	

Projections

The annual survey requests volume and radioactivity projections for three years after the survey year; Table 56 summarizes projections for 1993, 1994, and 1995. The projections indicate an elevation in waste volume due to decommissioning projects (Yankee Rowe, Texas Instruments and Watertown Arsenal) expected to be completed prior to June of 1994, when the current contract providing access to the Barnwell commercial disposal facility is scheduled to end. After 1994, the data indicates the annual amount of LLRW requiring disposal in a licensed facility will fall below the Board's 1991 projection of 30,000 cubic feet to a value between 20,000 and 25,000 cubic feet. This decrease will be due to the termination of operational waste production by the Yankee Rowe nuclear power plant (until decommissioning resumes around the year 2000) and the initiation of a recycling program by Nuclear Metals, Incorporated, that is projected to reduce their annual LLRW generation rate.

Radioactivity is expected to continue to fluctuate, as in the past, depending upon the activities of the nuclear power plants and major commercial producers. The Management Board will continue to request volume and activity projections from radioactive material users to confirm and update its projections.

Table 56
Volume and Radioactivity Projections for LLRW to be Shipped for Disposal
(cubic feet or curies)

	Volume			Activity		
Generator Catagory	1993	1994	1995	1993	1994	1995
Academic	818.0	716.0	684.0	2.7	2.7	2.7
Commercial	35,203.0	9,984.0	9,190.0	32,738.0	47,860.0	32,060.0
Government	78,004.0	7.5	11.5	0.0	0.0	0.0
Health	1,338.0	1,353.0	1,346.0	0.4	0.4	0.4
Utility	13,655.4	22,780.0	10,225.0	147,626.0	196,324.0	50,600.0
Total	129,018.4	34,840.5	21,456.5	180,367.1	244,187.1	82,663.1

8. Appendices

Appendix A: Massachusetts Radioactive Waste Producer Information

Table A–1: 1992 Survey Non–Respondents.
Table A–2: Inventory of Radioactive Material Users that Produced LLRW during 1992.
Table A–3: Volume Summary of Treatment Practices Utilized by 1992 Producers of LLRW.
Table A–4: Ranking by Volume of Radioactive Materials Users that Shipped LLRW for Disposal During 1992.
Table A–5: Ranking by Radioactivity of Radioactive Materials Users that Shipped LLRW for Disposal During 1992.
Table A–6: 1992 Volume and Radioactivity Shipped for Disposal by County.

Appendix B: Radioactivity Information

Table B–1: Inventory of Radionuclides Shipped for Disposal During 1992: Nuclides with less than 90 day Half–Lives.
Table B–2: Inventory of Radionuclides Shipped for Disposal During 1992: Nuclides with Half–Lives Greater than 90 days and less than Five Years.
Table B–3: Inventory of Radionuclides Shipped for Disposal During 1992: Nuclides with Greater than Five Year Half–Lives.
Table B–4: Elements.

Appendix C: Survey Form Description

Appendix A: Massachusetts Radioactive Waste Producer Information

Table A–1
1992 Survey Non–Respondents

Organization	City/Town
Amira, Inc.	Cambridge
Butkin Precision Engineering	North Adams
Cambridge Biotech Corporation	Worcester
Collaborative Biomedical	Bedford
Collaborative Research Inc.	Waltham
Cooley Dickinson Hospital	Northampton
Genesis Pharmaceuticals, Inc.	Cambridge
Gentest Corporation	Woburn
Manlabs, Inc.	Cambridge
Mercy Hospital	Springfield
Providence Hospital	Holyoke
Silverman Brothers	Lawrence
Saint Anne's Hospital	Fall River
Tobey Hospital	Wareham
Wing Memorial Hospital	Palmer

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992

County	City	Organization	Reason for use of Radioactive Materials
Barnstable	Falmouth	Falmouth Hospital	Diagnostic nuclear medicine
Barnstable	Hyannis	Cape Cod Hospital	Diagnostic nuclear medicine
Barnstable	Hyannis	Cardiac Imaging, Inc.	Nuclear diagnostic imaging
Barnstable	Woods Hole	Marine Biological Laboratory	Biomedical research and education
Barnstable	Woods Hole	Woods Hole Oceanographic Institute	Research
Berkshire	Great Barrington	Fairview Hospital	Nuclear medicine
Berkshire	North Adams	North Adams Regional Hospital	Diagnostic nuclear medicine
Berkshire	North Adams	Sprague Electric Co.	Decommissioning waste awaiting shipment
Berkshire	Pittsfield	Berkshire Medical Center	Medical use
Berkshire	Pittsfield	Hillcrest Hospital	Diagnostic nuclear medicine
Berkshire	Williamstown	Williams College	Teaching and research
Bristol	Attleboro	Sturdy Memorial Hospital	Diagnostic nuclear medicine
Bristol	Attleboro	Texas Instruments	Remediation of soils at a former LLRW burial site
Bristol	Fall River	Charlton Memorial Hospital	Diagnostic nuclear medicine
Bristol	Mansfield	Clinical Science Laboratory, Inc.	In–vitro testing
Bristol	New Bedford	Prym\Dritz Corporation	Static electricity eliminators
Bristol	New Bedford	St Luke's Hospital	Diagnostic nuclear medicine
Bristol	North Attleboro	Mallinckrodt Medical, Inc.	Manufacture and distribution of radioactive pharmaceuticals
Bristol	North Dartmouth	Massachusetts, University of	Research and teaching
Bristol	Norton	Wheaton College	Research and teaching
Bristol	Taunton	Morton Hospital and Medical Center	Diagnostic nuclear medicine
Dukes	Oak Bluffs	Martha's Vineyard Hospital	Diagnostic nuclear medicine
Essex	Amesbury	Amesbury Hospital	Diagnostic imaging
Essex	Andover	Eisai Research Institute	Research and development using biological assays

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Essex	Andover	Raytheon Company	Testing of semiconductor components
Essex	Beverly	Autogen Instrumentation, Inc.	Research & development
Essex	Beverly	Beverly Hospital	Diagnostic nuclear medicine
Essex	Beverly	New England Biolabs, Inc.	Biotechnology Research and development
Essex	Beverly	Varian Associates	Manufacture of electron devices
Essex	Danvers	Diagnostic Management Services, Inc.	Diagnostic nuclear medicine
Essex	Danvers	W R Grace & Co. Amicon Div.	Measurement of product separation properties
Essex	Gloucester	Addison Gilbert Hospital	Diagnostic nuclear medicine
Essex	Haverhill	Hale Hospital	Clinical nuclear medicine
Essex	Lawrence	Lawrence General Hospital	Diagnostic nuclear medicine
Essex	Lawrence	Massachusetts Dept. of Environmental Protection	Gas chromatography
Essex	Lynn	AtlantiCare Medical Center	Diagnostic nuclear medicine
Essex	Lynn	General Electric Co.	Chemical analysis of samples
Essex	Methuen	Holy Family Hospital and Medical Center	Diagnostic and therapeutic treatment of patients
Essex	Newburyport	Anna Jaques Hospital	Nuclear medicine
Essex	North Andover	AT & T Network Systems	Leak testing, measurement of thickness and density
Essex	North Andover	Mediq Imaging Services, Inc.	Nuclear medicine diagnostic imaging
Essex	North Andover	RTS Technology Inc.	Manufacture of sealed sources for radiation therapy and industrial radiography
Essex	Peabody	J B. Thomas Hospital	Diagnostic nuclear medicine
Essex	Salem	EG&G, Inc.	Development, manufacture, testing, distribution of electron tubes
Essex	Salem	New England Power Co.	Measurement of coal flyash level
Essex	Salem	Salem Hospital	Nuclear medicine
Franklin	Greenfield	Franklin Medical Center	Diagnostic nuclear medicine
Hampden	Chicopee	Our Lady of the Elms College	Training and teaching

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Hampden	Chicopee	Westover AFB	Compasses useing sealed tritium sources
Hampden	Holyoke	Holyoke Hospital	Diagnostic nuclear medicine
Hampden	Ludlow	Ludlow Hospital	Diagnostic nuclear medicine
Hampden	Springfield	Baystate Medical Center	Nuclear diagnostic medicine, radiation therapy, radioimmunoassay
Hampden	Springfield	Cameo Diagnostic Center, Inc.	Diagnostic nuclear medicine
Hampden	Springfield	Interstate Nuclear Services	Laundering of protective clothing
Hampden	Westfield	Noble Hospital	Nuclear medicine imaging
Hampshire	Amherst	Amherst College	Scientific research and teaching
Hampshire	Amherst	Massachusetts, University of	Life and physical research and teaching
Hampshire	Northampton	Smith College	Research and teaching
Hampshire	Northampton	VA Hospital Northhampton	Diagnostic nuclear medicine
Hampshire	South Hadley	Mount Holyoke College	Laboratory research
Middlesex	Arlington	Symmes Hospital	Clinical nuclear medicine
Middlesex	Ayer	Nashoba Community Hospital	Diagnostic nuclear medicine
Middlesex	Bedford	CIS–US, Inc.	Manufacture and distribution of radiopharmaceuticals
Middlesex	Bedford	Millipore Corporation	Analytical Research
Middlesex	Bedford	ENRM VA Hospital	Medical Research
Middlesex	Billerica	Du Pont Merck Pharmaceutical Co.	Manufacture of radiopharmaceutical products
Middlesex	Billerica	E I. Du Pont De Nemours and Co.	Manufacture of radiopharmaceutical products
Middlesex	Billerica	E I. Du Pont De Nemours and Co.	Manufacture of radiopharmaceutical products
Middlesex	Burlington	Amersham Corporation	Manufacture of industrial radiography sealed sources
Middlesex	Burlington	Lahey Clinic Medical Center	Diagnostic nuclear medicine
Middlesex	Burlington	Millipore Corporation	Life science research and development
Middlesex	Burlington	M/A–COM, Inc.	Manufacture of microwave receiver protector tubes

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Middlesex	Cambridge	Advanced Magnetics, Inc.	Manufacture of diagnostic and research reagents
Middlesex	Cambridge	American Science & Engineering, Inc.	Instument calibration
Middlesex	Cambridge	Applied bioTechnology, Inc.	Molecular biology & protein chemistry
Middlesex	Cambridge	Ariad Pharmaceuticals, Inc.	Biotechnology research and development
Middlesex	Cambridge	Arthur D. Little, Inc.	Biochemical experimentaion.
Middlesex	Cambridge	BASF Bioresearch Corp.	Biotechnology research & development
Middlesex	Cambridge	Biogen, Inc.	Biotechnology research and development
Middlesex	Cambridge	Bioran Medical Laboratory	Medical laboratory testing
Middlesex	Cambridge	BioSurface Technology, Inc.	Radiolabeling of materials
Middlesex	Cambridge	Boston Heart Foundation	Biochemical/biological research
Middlesex	Cambridge	Cambridge Neuroscience Research	Bio–research
Middlesex	Cambridge	Charles Stark Draper Lab, Inc.	Radiation hardness testing of electronic and mechanical components
Middlesex	Cambridge	CytoMed, Inc.	Bioassay tracers, molecular biological probes, radioimmunoassays
Middlesex	Cambridge	Enzytech, Inc.	Radioimmunoassays
Middlesex	Cambridge	Genetics Institute	Research & development
Middlesex	Cambridge	Genzyme Corp.	Molecular biology, DNA probe testing, enzyme assay
Middlesex	Cambridge	ImmuLogic Pharmaceutical Corp.	Biomedical research
Middlesex	Cambridge	ImmunoGen, Inc.	Biochemical & biological research
Middlesex	Cambridge	International Biotechnology Labs, Inc.	Research and development of biotechnological products
Middlesex	Cambridge	Massachusetts Institute of Technology	Research and teaching
Middlesex	Cambridge	Matritech, Inc.	Research and development of cancer diagnostic assays
Middlesex	Cambridge	Metpath, Inc.	Clinical diagnostic testing
Middlesex	Cambridge	Morgan , Charles T. Co., Inc.	Distribution of Instruments
Middlesex	Cambridge	Mt. Auburn Hospital	Diagnostic nuclear medicine

Table A–2

Inventory of Radioactive Material Users That Produced LLRW during 1992

(continued)

County	City	Organization	Reason for use of Radioactive Materials
Middlesex	Cambridge	OmniGene, Inc.	Biochemical research
Middlesex	Cambridge	Oravax, Inc.	Biomedical research
Middlesex	Cambridge	Organogenesis, Inc.	Research and development of medical devices
Middlesex	Cambridge	Osteo Arthritis Sciences	Biotechnology research and development
Middlesex	Cambridge	Peptimed, Inc.	Laboratory activities in biotechnology
Middlesex	Cambridge	PharmaMar USA, Inc.	In–vitro biological experiments
Middlesex	Cambridge	Procept, Inc.	Biotechnology research and development
Middlesex	Cambridge	Protein Engineering Corp.	Research and development of therapeutic and diagnostic products
Middlesex	Cambridge	Shared Diagnostic Services	Diagnostic nuclear medicine
Middlesex	Cambridge	T Cell Sciences, Inc.	Research and development of pharmaceuticals
Middlesex	Cambridge	Therion Biologics Corporation	Molecular biological and protein chemistry
Middle[illegible]	Cambridge	Transkaryotic Therapies, Inc.	Molecular biological probes, radioimmunoassays
Middlesex	Cambridge	TRW Fasteners Division	No longer use RAM
Middlesex	Cambridge	Vertex Pharmaceuticals	Research and development of human pharmaceuticals
Middlesex	Cambridge	Whitehead Institute for Biomedical Research	Biomedical, cancer, and aids research
Middlesex	Cambridge	Alkermes, Inc.	Pharmaceutical research and development
Middlesex	Chestnut Hill	Boston College	Research and teaching
Middlesex	Concord	Emerson Hospital	Diagnostic nuclear medicine
Middlesex	Concord	Nuclear Metals, Inc.	Manufacture of depleted uranium products and components
Middlesex	Concord	Oxford Analytical, Inc.	Service of XRF (lead paint detectors) analysers
Middlesex	Everett	Whidden Memorial Hospital	Diagnostic nuclear medicine
Middlesex	Framingham	Betagen Corporation	Research and development of laboratory instrumentation
Middlesex	Framingham	Framingham Heart Study	Analysis of bone minerals
Middlesex	Framingham	Gene – Trak Systems	DNA/RNA Research

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Middlesex	Hopkinton	Biomeasure, Inc.	Research in life sciences
Middlesex	Hopkinton	Creative Biomolecules, Inc.	Animal studies
Middlesex	Hopkinton	Liberty Mutual Insurance Co.	Gas chromatography
Middlesex	Hopkinton	Seragen, Inc.	Biomedical research and development
Middlesex	Lexington	Environmental Protection Agency	Gas chromatography
Middlesex	Lexington	Interneuron Pharmaceuticals, Inc.	Biochemical assays
Middlesex	Lexington	Kendall Co., Polyken Technologies Division	Analytical equipment
Middlesex	Lexington	Repligen Sandoz Research Corp.	Protein labeling
Middlesex	Lexington	WR Grace & Co.	RIA assays
Middlesex	Lowell	Lowell General Hospital	Medical use for diagnostic and therapeutic purposes
Middlesex	Lowell	Lowell, University of Massachusetts	Research and training
Middlesex	Lowell	St John's Hospital	Diagnostic nuclear medicine
Middlesex	Lowell	St Joseph's Hospital	Diagnostic nuclear medicine
Middlesex	Malden	Charm Sciences, Inc.	Manufacture of in–vitro diagnostic kits
Middlesex	Malden	Enzyme Center	Manufacture of in–vitro diagnostic kits
Middlesex	Marlboro	Optical Corporation of America	Manufacture of gunsights
Middlesex	Marlborough	Marlborough Hospital	Clinical nuclear medicine
Middlesex	Medford	Lawrence Memorial Hospital of Medford	Diagnostic nuclear medicine
Middlesex	Medford	Tufts University	Radiolabeling in bichemical and chemical experimentation
Middlesex	Melrose	Melrose\Wakefield Hospital	Medical diagnostic imaging
Middlesex	Natick	Army, Department of	Research and development as defined in Title 10, CFR Sec. 30.4
Middlesex	Natick	Boston Fertility Lab, Inc.	Diagnostic testing
Middlesex	Natick	Imaging Associates, Inc.	Diagnostic nuclear medicine
Middlesex	Needham Heights	GTE Government Sys Corp.	Semiconductor research and development

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Middlesex	Newton	Cellcor Therapies, Inc.	Medical research and cancer treatment assessment
Middlesex	Newton	Hygeia Sciences	Quality control and testing of uptake filters
Middlesex	Newton	Newton–Wellesley Hospital	Nuclear medicine program
Middlesex	Somerville	Somerville Hospital	Nuclear medicine studies
Middlesex	Somerville	Vicam	Research and development for food analysis test kits
Middlesex	Stoneham	New England Memorial Hospital	Diagnostic nuclear medicine
Middlesex	Sudbury	Raytheon Company	Electronics research and development
Middlesex	Waltham	Brandeis University	Basic research in physics, biology, biochemistry, and chemistry
Middlesex	Waltham	Digital Scintigraphics	Nuclear medicine
Middlesex	Waltham	Eunice Kennedy Shriver Center	Biomedical research and clinical assays
Middlesex	Waltham	Panametrics, Inc.	Research and development on radioisotope uses and insrtumentation
Middlesex	Waltham	Polaroid Corporation	Measurement of thickness and density
Middlesex	Waltham	Raytheon Company	Manufacture of electron tube cathodes
Middlesex	Waltham	Skinner & Sherman Laboratories	Analysis of soil samples
Middlesex	Waltham	SmithKline Beecham Clinical Laboratory	In–vitro diagnostic testing
Middlesex	Waltham	Waltham\Weston Hospital and Medical Center	Diagnostic nuclear medicine
Middlesex	Watertown	Army, Department of	Decommissioning of Watertown Arsenal
Middlesex	Watertown	Radiation Monitoring Devices, Inc.	Calibration of radiation detectors
Middlesex	Wilmington	Charles River Labs., Inc.	Molecular DNA analysis
Middlesex	Wilmington	New England Pathology Services	In–vitro biomedical testing
Middlesex	Winchester	Winchester Hospital	Diagnostic nuclear medicine
Middlesex	Winchester	Health & Human Services, Department of	Research and development
Middlesex	Winthrop	Winthrop Hospital	Diagnostic nuclear medicine
Middlesex	Woburn	Biotechnology Management Association	Product testing of biotech and pharmaceutical products

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Middlesex	Woburn	BIOTEK, Inc.	Research and development on medical products
Middlesex	Woburn	Crystal Diagnostics, Inc.	Research and development of gas measuring devices
Middlesex	Woburn	Micro–Dynamics, Inc.	Manufacture of microwave radar components
Middlesex	Woburn	Syncor International Corp.	Compounding and distribution of radiopharmaceuticals
Norfolk	Braintree	Clean Harbors Analytical Services, Inc.	Gas chromatography
Norfolk	Medfield	Ciba Corning Diagnostics Corp.	No use of radioactive materials
Norfolk	Medfield	Strichman Medical Equipment	Diagnostic nuclear medicine
Norfolk	Milton	Milton Hospital	Diagnostic nuclear medicine
Norfolk	Needham	Glover Memorial Hospital	Diagnostic nuclear medicine
Norfolk	Needham	Repligen Corporation	Biotech research
Norfolk	Norfolk	Southwood Community Hospital	Diagnostic and therapeutic purposes
Norfolk	Norwood	Norwood Hospital	Diagnostic therapy
Norfolk	Quincy	Procter & Gamble Mfg. Co.	Mass flow and liquid level measurements
Norfolk	Quincy	Quincy City Hospital	Diagnostic nuclear medicine
Norfolk	Randolph	Ares Advanced Technology, Inc.	Research and development of pharmaceuticals
Norfolk	Randolph	Serono Laboratories, Inc.	Manufacture of I–125 bound proteins
Norfolk	South Weymouth	South Shore Hospital	Diagnostic nuclear medicine
Norfolk	Stoughton	Biomedical Technologies, Inc.	Manufacture of Iodine–125 labeled compounds
Norfolk	Stoughton	Goddard Memorial Hospital	Diagnostic nuclear medicine
Norfolk	Walpole	Ciba Corning Diagnostics Corp.	Manufacture, Research and development, of immunodiagnostic kits and reagents
Norfolk	Wellesley	Wellesley College	Teaching and research
Norfolk	Westwood	Damon Clinical Laboratories, Inc.	In–vitro testing
Norfolk	Westwood	PB Diagnostic Systems, Inc.	Research and development of medical diagnostic products
Plymouth	Bridgewater	Bridgewater State College	Teaching and research

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Plymouth	Brockton	Advacare Management Services	Medical diagnostic outpatient testing
Plymouth	Brockton	Brockton Hospital	Diagnostic nuclear medicine
Plymouth	Brockton	Cardinal Cushing General Hospital	Nuclear medicine
Plymouth	Duxbury	Battelle Ocean Sciences	Primary productivity studies
Plymouth	Plymouth	Bartlett Nuclear, Inc.	Mobile decontamination services
Plymouth	Plymouth	Boston Edison Co.	Generation of electricity
Plymouth	Plymouth	Jordan Hospital	Clinical nuclear medicine
Plymouth	Wareham	Springborn Laboratories, Inc.	Environmental fate and toxicology studies
Suffolk	Boston	Angell Memorial Animal Hospital	Diagnosis and therapy of animals
Suffolk	Boston	Beth Israel Hospital	Nuclear medicine, radiation therapy, endocrinology, clinical chemistry
Suffolk	Boston	Boston Biomedical Research Institute	Biomedical research
Suffolk	Boston	Boston City Hospital	Nuclear medicine, research, clinical procedures
Suffolk	Boston	Boston University	Teaching & research
Suffolk	Boston	Boston University Medical Ctr.	Medical research, patient care
Suffolk	Boston	Brigham & Women's Hospital	Patient care, research, service
Suffolk	Boston	Bunker Hill Community College	Teaching & research
Suffolk	Boston	Center for Blood Research	Laboratory tracer studies
Suffolk	Boston	Children's Hospital	Medical research and diagnosis
Suffolk	Boston	Dana–Farber Cancer Institute	Cancer research, diagnosis and therapy
Suffolk	Boston	Du Pont Medical Products	Manufacture of radiopharmaceutical products
Suffolk	Boston	Eye Research Institute of Retina Foundation	Biomedical research
Suffolk	Boston	Forsyth Dental Center	Biomedical research
Suffolk	Boston	Gillette Co., Toiletries Technology Laboratory	Radiotracer studies of toiletries products
Suffolk	Boston	Harvard University	Medical research and development, teaching

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Suffolk	Boston	Joslin Diabetes Center	Biomedical research & clinical assays
Suffolk	Boston	Life Signs\Group, Inc.	Clinical nuclear medicine
Suffolk	Boston	Massachusetts College of Pharmacy	Teaching and research
Suffolk	Boston	Massachusetts Eye & Ear Infirmary	Medical research and development
Suffolk	Boston	Massachusetts General Hospital	Medical diagnosis and therapy, research and development
Suffolk	Boston	Massachusetts, University of	Academic research
Suffolk	Boston	New England Aquarium	Basic applied research
Suffolk	Boston	New England Baptist Hospital	Diagnostic radionuclide scanning
Suffolk	Boston	New England Deaconess Hospital	Medical research
Suffolk	Boston	New England Medical Center	Diagnostic and therapeutic medical applications, biomedical research
Suffolk	Boston	Nissin Molecular Biology Institute, Inc.	Reverse transcript assay
Suffolk	Boston	Northeastern University	Research and teaching
Suffolk	Boston	Spaulding Rehabilitation Hospital	Clinical nuclear cardiology program
Suffolk	Boston	St Elizabeth's Hospital	Clinical nuclear medicine and research
Suffolk	Boston	Tufts University School of Medicine	Biomedical research and teaching
Suffolk	Boston	U.S.D.A. Human Nutritional Research Center	Biomedical research
Suffolk	Boston	VA Medical Center, Boston	Clinical nuclear medicine and nuclear cardiology studies
Suffolk	Charlestown	Diacrin, Inc.	Biochemical research
Suffolk	Dedham	American Red Cross Blood Services	Bone marrow transplantation screening, Irradiation of blood products
Suffolk	Dorchester	Carney Hospital	Clinical nuclear medicine
Suffolk	Janaica Plain	Faulkner Hospital	Nuclear medicine
Worcester	Clinton	LFE Industrial Systems Corp.	Manufacture of industrial gauges
Worcester	Fitchburg	Burbank Hospital	Diagnostic nuclear medicine
Worcester	Fitchburg	Fitchburg State College	Positron annihilation spectrascopy

Table A–2
Inventory of Radioactive Material Users That Produced LLRW during 1992
(continued)

County	City	Organization	Reason for use of Radioactive Materials
Worcester	Gardner	Henry Heywood Memorial Hospital	Nuclear medicine studies
Worcester	Leominster	Leominster Hospital	Diagnostic nuclear medicine
Worcester	Milford	Milford–Whitinsville Regional Hospital	Diagnostic nuclear medicine
Worcester	Milford	TSI Center for Diagnostic Products	Radioimmunoassay
Worcester	Millbury	Wyman–Gordan Company	Measurement of liquid level and gas purity
Worcester	Shrewsbury	Biohybrid Technologies	Radioimmunoassay procedures
Worcester	Shrewsbury	Digital Equipment Corp.	Static elimination, gas analysis
Worcester	Shrewsbury	Worcester Foundation for Experimental Biology	Biomedical research and development and teaching
Worcester	Southbridge	Harrington Memorial Hospital	Diagnostic nuclear medicine
Worcester	Springfield	Monsanto Chemical Co.	Sealed source within instruments
Worcester	Westboro	Yankee Atomic Electric Co.	Nuclear power plant decommissioning, laboratory services
Worcester	Worcester	Clark University	Research and teaching
Worcester	Worcester	College of the Holy Cross	Teaching and research
Worcester	Worcester	Genica Pharmaceuticals Co.	Enzyme Assays
Worcester	Worcester	Hybridon	Biomedical rsearch and development
Worcester	Worcester	Institute of Molecular Biology	Biotechnology research and development
Worcester	Worcester	Massachusetts, University of (Medical Center)	Patient diagnosis and treatment, biomedical research
Worcester	Worcester	Medical Center of Central MA (Memorial)	Patient diagnosis
Worcester	Worcester	Medical Center of Central MA (Hahneman)	Clinical nuclear medicine
Worcester	Worcester	St Vincent Hospital	Medical usage
Worcester	Worcester	Telesector Resources Group	Replacement of cathode electron tubes used in telephone switching equipment
Worcester	Worcester	TSI Mason Research Institute	RIA procedures, tissue distribution, blood clearance studies
Worcester	Worcester	Worcester Polytechnic Institute	Teaching and research

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Addison Gilbert Hospital	0.0		0.0	5.0	0.0	0.0	0.0	
Advacare Management Services	0.0		0.0	133.0	0.0	90.5	0.0	
Advanced Magnetics, Inc.	53.9	10, 18	38.9	206.5	0.0	0.0	5.0	10
Alkermes, Inc.	385.1	10	45.5	7.5	0.0	0.0	0.0	9
American Red Cross Blood Services	0.0		0.0	0.0	4.0	0.0	0.5	
American Science & Engineering, Inc.	4.0		0.0	0.0	0.0	0.0	0.0	
Amersham Corporation	30.0		30.0	3.0	0.0	90.0	279.5	1
Amesbury Hospital	0.0		0.0	6.0	0.0	0.0	0.0	
Amherst College	0.0		0.0	4.0	0.0	0.0	0.0	
Angell Memorial Animal Hospital	0.0		0.0	80.0	0.0	0.0	0.0	
Anna Jaques Hospital	0.0		0.0	20.0	0.0	0.0	0.0	
Applied bioTechnology, Inc.	22.5	1	22.5	7.5	0.0	0.0	0.0	2
Ares Advanced Technology, Inc.	0.0		0.0	169.0	0.0	0.0	0.0	
Ariad Pharmaceuticals, Inc.	0.0		0.0	6.0	0.0	0.0	2.7	
Army, Department of	277.5	9	277.5	0.0	0.0	0.0	0.0	79
Army, Department of (Natick)	0.0		0.0	21.5	0.0	0.0	30.9	
Arthur D. Little, Inc.	15.0		15.0	0.0	0.0	0.0	0.0	1
AT & T Network Systems	0.0		0.0	0.0	0.0	0.0	0.0	
AtlantiCare Medical Center	6.6		6.6	100.0	0.0	0.0	0.0	1
Autogen Instrumentation, Inc.	0.0		0.0	4.5	0.0	0.0	0.0	
Bartlett Nuclear, Inc.	0.0		0.0	0.0	0.0	0.0	7,000.0	
BASF Bioresearch Corp.	180.5	10	165.5	0.0	0.0	0.0	0.0	5

Table A–3
Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992
(cubic feet)
(continued)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On−site	
Battelle Ocean Sciences	0.0		0.0	0.0	0.0	0.0	2.0	1
Baystate Medical Center	0.0		0.0	50.0	0.0	52.0	0.0	
Berkshire Medical Center	0.0		0.0	100.0	0.0	400.0	0.0	
Betagen Corporation	0.0		0.0	5.0	0.0	0.0	0.8	
Beth Israel Hospital	142.5	10	60.0	1,791.4	36.0	0.0	0.0	19
Beverly Hospital	0.0		0.0	4.0	0.0	0.0	0.0	
Biogen, Inc.	37.5	10	30.0	233.[illegible]	0.0	0.0	0.0	2
Biohybrid Technologies	0.0		0.0	150.0	0.0	0.0	0.0	
Biomeasure, Inc.	0.0		0.0	0.0	0.0	0.0	0.0	
Biomedical Technologies, Inc.	0.0		0.0	27.0	0.0	0.0	0.0	
Bioran Medical Laboratory	0.0		0.0	0.0	0.0	0.0	0.0	
BioSurface Technology, Inc.	0.0		0.0	32.0	0.0	0.0	16.0	
Biotechnology Management Association	0.0		0.0	10.0	0.0	0.0	0.0	
BIOTEK, Inc.	22.5	10	7.5	0.0	0.0	0.0	0.0	3
Boston Biomedical Research Institute	0.0		0.0	0.0	0.8	0.0	0.0	
Boston City Hospital	7.5	2	7.5	154.5	0.0	0.0	0.0	12
Boston College	452.2	1	118.3	27.1	0.0	0.0	0.0	4
Boston Edison Co.	28,446.0	4, 10	2,075.0	0.0	0.0	0.0	445.7	34
Boston Heart Foundation	0.0		0.0	3.0	0.0	0.0	0.0	
Boston University	86.5	3, 10	15.6	180.3	0.0	0.0	0.0	4
Boston University Medical Ctr.	369.6	2, 9, 10	104.7	446.5	0.0	0.0	0.0	11
Brandeis University	219.1	4, 10	84.1	112.5	0.0	0.0	0.0	8

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Brigham & Women's Hospital	310.5	10	19.0	2,160.5	381.8	0.0	0.0	4
Brockton Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Bunker Hill Community College	0.0		0.0	15.0	0.0	0.0	0.0	
Burbank Hospital	0.0		0.0	27.7	0.0	84.0	0.0	
Cambridge Neuroscience Research	314.6	3, 10	89.8	4.5	0.0	0.0	27.6	12
Cameo Diagnostic Center, Inc.	0.0		0.0	7.5	0.0	0.0	0.0	
Cape Cod Hospital	0.0		0.0	100.0	0.0	50.0	0.0	
Cardiac Imaging, Inc.	0.0		0.0	10.0	0.0	0.0	0.0	
Cardinal Cushing General Hospital	0.0		0.0	6.0	0.0	0.0	0.0	
Carney Hospital	0.0		0.0	8.0	0.0	3.0	0.0	
Cellcor Therapies, Inc.	8.0		8.0	0.0	0.0	0.0	0.0	2
Center for Blood Research	60.0	1, 10	5.0	470.0	0.0	0.0	0.0	3
Charles River Labs., Inc.	0.0		0.0	10.0	0.0	0.0	0.0	
Charles Stark Draper Lab, Inc.	0.0		0.0	4.0	0.0	0.0	0.0	
Charlton Memorial Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Charm Sciences, Inc.	0.0		0.0	0.0	0.0	0.0	0.5	
Children's Hospital	183.0	10	17.0	1,386.0	170.0	0.0	0.0	5
Ciba Corning Diagnostics Corp. (Medfield)	0.0		0.0	7.5	0.0	0.0	0.0	
Ciba Corning Diagnostics Corp. (Walpole)	28.1	10	0.0	1,858.8	0.0	0.0	0.0	4
CIS–US, Inc.	7.5	1	6.2	12.3	0.0	0.0	11.3	1
Clark University	0.0		0.0	7.5	0.0	0.0	0.0	
Clean Harbors Analytical Services, Inc.	15.0	10	0.0	0.0	0.0	0.0	0.0	

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated^1 Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code^2	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Clinical Science Laboratory, Inc.	0.0		0.0	175.0	0.0	0.0	0.0	
College of the Holy Cross	22.5	9, 10	15.0	0.0	0.0	0.0	0.0	1
Creative Biomolecules, Inc.	105.0	10	90.0	0.0	0.0	0.0	0.0	4
Crystal Diagnostics, Inc.	12.2	1, 10	3.1	0.0	0.0	0.0	0.0	2
CytoMed, Inc.	60.0	1, 10	5.0	18.8	0.0	0.0	15.0	2
Damon Clinical Laboratories, Inc.	0.0		0.0	1,075.4	0.0	0.0	49.2	
Dana–Farber Cancer Institute	175.2	10	7.3	1,857.4	313.2	0.0	0.0	6
Diacrin, Inc	45.0	1	15.0	0.0	0.0	0.0	15.0	
Diagnostic Management Services, Inc.	0.0		0.0	7.5	0.0	0.0	0.0	
Digital Scintigraphics	0.0		0.0	10.0	0.0	0.0	0.0	
Du Pont Medical Products	10,911.5	4, 10	2,246.8	1,500.0	0.0	0.0	4,785.0	19
Du Pont Merck Pharmaceutical Co.	3,785.2	4	530.6	6,652.5	0.0	0.0	166.0	8
E I. Du Pont De Nemours and Co.	984.8	4	215.8	1,335.0	0.0	0.0	307.5	8
E I. Du Pont De Nemours and Co. (o)	161.5	4	79.9	0.0	0.0	0.0	843.0	3
EG&G, Inc.	7.5	4	2.0	0.0	0.0	0.0	3.8	1
Eisai Research Institute	31.0	1, 10	3.0	10.0	0.0	0.0	0.0	2
Emerson Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Environmental Protection Agency	0.0		0.0	0.0	0.0	0.5	0.0	
Enzyme Center	0.0		0.0	40.0	0.0	0.0	0.0	
Enzytech, Inc.	37.5	10	30.0	0.0	0.0	0.0	12.0	2
Eunice Kennedy Shriver Center	1.5		1.5	23.1	3.2	0.0	0.0	2
Eye Research Institute of Retina Foundation	5.0	10	0.0	43.7	14.1	0.0	0.0	

Table A–3
Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992
(cubic feet)
(continued)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Fairview Hospital	0.0		0.0	9.0	0.0	0.0	0.0	
Falmouth Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Faulkner Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Fitchburg State College	0.0		0.0	0.0	0.0	0.0	5.0	1
Forsyth Dental Center	0.0		0.0	30.0	8.7	0.0	0.0	
Franklin Medical Center	0.0		0.0	4.0	0.0	0.5	0.0	
Gene – Trak Systems	157.5	1, 10	7.5	690.0	0.0	0.0	90.0	2
General Electric Co. (Lynn)	5.1		5.1	0.0	0.0	0.0	0.0	1
Genetics Institute	405.0	1, 10	300.0	22.5	0.0	0.0	52.5	15
Genica Pharmaceuticals Co.	3.0	10	1.5	0.0	0.0	0.0	0.0	
Genzyme Corp.	0.0		0.0	992.0	0.0	0.0	9.0	3
Gillette Co., Toiletries Technology Laboratory	0.0		0.0	0.0	0.0	0.0	2.4	
Glover Memorial Hospital	0.0		0.0	2.0	0.0	0.0	0.0	
Goddard Memorial Hospital	0.0		0.0	10.0	0.0	0.0	0.0	
GTE Government Sys Corp	0.0		0.0	0.0	0.0	0.5	0.0	
Hale Hospital	0.0		0.0	2.0	0.0	4.0	0.0	
Harrington Memorial Hospital	0.0		0.0	6.0	0.0	10.0	0.0	
Harvard University	684.1	1, 10	92.8	2,571.3	1,134.5	0.0	0.0	16
Health & Human Services, Department of	19.1		19.1	11.5	0.0	0.0	0.0	1
Henry Heywood Memorial Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Hillcrest Hospital	0.0		0.0	10.0	0.0	0.0	0.0	
Holy Family Hospital and Medical Center	0.0		0.0	60.0	0.0	104.0	0.0	

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Holyoke Hospital	0.0		0.0	40.0	0.0	52.0	0.0	
Hybridon	0.0		0.0	25.5	0.0	0.0	0.0	
Hygeia Sciences	0.0		0.0	7.5	0.0	0.0	0.0	
Imaging Associates, Inc.	0.0		0.0	2.0	0.0	0.0	0.0	
ImmuLogic Pharmaceutical Corp.	60.5	10	52.5	7.5	0.0	0.0	0.0	7
ImmunoGen, Inc.	9.0	10	4.5	64.5	0.0	0.0	15.0	2
nstitute of Molecular Biology	157.5	1, 10	45.0	0.0	0.0	0.0	0.0	9
International Biotechnology Labs, Inc.	7.5	1	2.5	0.4	0.0	0.0	0.1	
Interneuron Pharmaceuticals Inc.	7.5	10	0.0	4.0	0.0	0.0	0.0	
Interstate Nuclear Services	1,417.7	4	397.5	0.0	0.0	0.0	282.3	1
J B. Thomas Hospital	0.0		0.0	7.5	0.0	2.0	0.0	
Jordan Hospital	0.0		0.0	12.0	0.0	4.0	0.0	
Joslin Diabetes Center	82.5	1, 10	2.9	606.9	55.1	0.0	0.0	2
Lahey Clinic Medical Center	0.0		0.0	70.0	0.0	7.6	0.0	
Lawrence General Hospital	0.0		0.0	16.0	0.0	0.0	0.0	
Lawrence Memorial Hospital of Medford	0.0		0.0	10.0	0.0	0.0	0.0	
Leominster Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
LFE Industrial Systems Corp.	0.0		0.0	0.0	0.0	10.0	0.0	
Liberty Mutual Insurance Co.	4.0	4	4.0	0.0	0.0	0.0	0.0	1
Life Signs\Group, Inc.	0.0		0.0	10.0	0.0	5.1	0.0	
Lowell General Hospital	0.0		0.0	3.0	0.0	3.0	0.0	
Lowell, University of Massachusetts	0.0		0.0	36.0	0.0	0.0	8.0	

Table A–3
Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Ludlow Hospital	0.0		0.0	5.0	0.0	0.0	0.0	
Mallinckrodt Medical, Inc.	8.0	1, 14	8.0	542.0	0.0	0.0	2.0	14
Marine Biological Laboratory	109.0	4, 10	60.3	16.4	0.0	0.0	0.0	2
Marlborough Hospital	0.0		0.0	4.0	0.0	1.0	0.0	
Martha's Vineyard Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Massachusetts College of Pharmacy	0.0		0.0	2.0	0.0	0.0	0.0	
Massachusetts Eye & Ear Infirmary	2.3	10	1.1	176.7	6.2	0.0	0.0	1
Massachusetts General Hospital	185.3	1, 10	11.0	3,882.0	519.0	0.0	0.0	3
Massachusetts Institute of Technology	859.1	10	420.0	682.5	0.0	0.0	0.0	9
Massachusetts, University of	0.0		0.0	330.0	0.0	0.0	15.0	
Massachusetts, University of (Dartmouth)	0.0		0.0	4.0	0.0	0.0	0.0	
Massachusetts, University of (Harbor Campus)	15.0		15.0	52.5	0.0	0.0	0.0	1
Massachusetts, University of (Medical Center)	22.5	10	15.0	2,907.0	500.0	0.0	83.5	3
Matritech, Inc.	0.0		0.0	61.0	0.0	0.0	0.0	
Medical Center of Central MA (Memorial)	0.0		0.0	2.0	0.0	0.0	0.0	
Medical Center of Central MA (Hahneman)	0.0		0.0	6.0	0.0	6.0	0.0	
Mediq Imaging Services, Inc.	0.0		0.0	0.0	0.0	90.0	0.0	
Melrose/Wakefield Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Metpath, Inc.	106.0		106.0	0.0	0.0	0.0	0.0	11
Micro–Dynamics, Inc.	16.0		16.0	0.0	0.0	0.0	4.0	1
Milford–Whitinsville Regional Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Millipore Corporation (Bedford)	0.0		0.0	22.5	0.0	0.0	40.5	

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated^1 Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code^2	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Millipore Corporation (Burlington)	19.0	10	15.0	0.0	0.0	0.0	0.0	
Milton Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Morton Hospital and Medical Center	0.0		0.0	20.0	0.0	30.0	0.0	
Mount Holyoke College	0.0		0.0	15.0	0.0	0.0	0.0	
Mt. Auburn Hospital	0.0		0.0	81.8	0.0	13.5	0.0	
M/A–COM, Inc.	24.1	1	24.1	0.0	0.0	0.0	0.0	4
Nashoba Community Hospital	0.0		0.0	12.0	0.0	0.0	0.0	
New England Aquarium	0.0		0.0	0.0	0.0	0.0	2.1	
New England Baptist Hospital	0.0		0.0	12.0	0.0	0.0	0.0	
New England Biolabs, Inc.	0.0		0.0	45.0	0.0	0.0	0.0	
New England Deaconess Hospital	763.2	1, 10	410.7	0.0	0.0	0.0	0.0	13
New England Medical Center	420.0	1, 10	189.0	465.3	0.0	24.0	0.0	8
New England Memorial Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
New England Pathology Services	0.0		0.0	200.0	0.0	0.0	0.0	
New England Power Co. (Salem)	5.5	11	1.1	0.0	0.0	0.0	0.0	1
Newton–Wellesley Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Nissin Molecular Biology Institute, Inc.	4.0	1	4.0	5.0	0.0	0.0	0.0	1
Noble Hospital	0.0		0.0	10.0	0.0	0.0	0.0	
North Adams Regional Hospital	0.0		0.0	8.0	0.0	3.0	0.0	
Northeastern University	244.6	10	132.3	13.0	0.0	0.0	0.0	6
Norwood Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Nuclear Metals, Inc.	6,266.3	4, 10	410.6	0.0	0.0	0.0	0.0	14

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
OmniGene, Inc.	0.0		0.0	82.5	0.0	0.0	7.5	
Optical Corporation of America	1.0		1.0	0.0	0.0	0.0	7.8	1
Oravax, Inc.	0.0		0.0	0.0	0.0	0.0	0.0	
Organogenesis, Inc.	124.0	1, 10	94.0	0.0	0.0	0.0	0.0	3
Osteo Arthritis Sciences	0.0		0.0	0.0	0.0	0.0	22.5	
Our Lady of the Elms College	0.0		0.0	0.0	0.0	0.0	2.0	
Oxford Analytical, Inc.	0.5		0.5	0.0	0.0	0.0	0.0	1
Panametrics, Inc.	6.7	13	9.8	0.0	0.0	0.1	0.0	3
PB Diagnostic Systems, Inc.	30.0		30.0	2.5	0.0	0.0	0.0	1
Peptimed, Inc.	0.0		0.0	5.0	0.0	0.0	0.0	
PharmaMar USA, Inc.	0.0		0.0	0.0	0.0	0.0	7.5	
Polaroid Corporation	0.0		0.0	0.0	0.0	1.0	0.0	
Procept, Inc.	101.5	1, 10	9.4	19.0	0.0	0.0	0.0	6
Procter & Gamble Mfg. Co.	0.0		0.0	0.0	0.0	1.0	0.0	
Protein Engineering Corp.	0.0		0.0	9.7	0.0	0.0	2.7	
Prym/Dritz Corporation	7.5		7.5	0.0	0.0	0.0	0.0	1
Quincy City Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Raytheon Company (Andover)	0.0		0.0	0.0	0.0	1.0	0.0	
Raytheon Company (Sudbury)	0.0		0.0	0.0	0.0	0.0	1.0	
Raytheon Company (Willow St. Waltham)	500.0		500.0	0.0	0.0	0.0	15.0	1
Repligen Corporation	71.5	3, 10	14.8	82.5	0.0	0.0	22.5	4
Repligen Sandoz Research Corp.	11.5	10	4.0	0.0	0.0	0.0	0.0	2

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated[1] Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
RTS Technology Inc.	0.0		0.0	15.0	0.0	0.0	0.0	
Salem Hospital	0.0		0.0	15.0	0.0	0.0	0.0	
Seragen, Inc.	473.5	1, 10	342.0	0.0	0.0	0.0	0.0	12
Serono Laboratories, Inc.	108.3	1	50.4	24.1	0.0	0.0	0.0	1
Shared Diagnostic Services	0.0		0.0	0.0	0.0	7.5	0.0	
Skinner & Sherman Laboratories	0.0		0.0	0.0	0.0	0.0	6.0	
Smith College	38.0	10, 12, 14	18.8	1.5	0.0	0.0	0.0	2
SmithKline Beecham Clinical Laboratory	232.7		232.7	0.0	0.0	0.0	0.0	3
Somerville Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
South Shore Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
Southwood Community Hospital	0.0		0.0	27.0	0.0	0.0	0.0	
Spaulding Rehabilitation Hospital	0.0		0.0	10.0	0.0	0.0	0.0	
Sprague Electric Co.	22.0		22.0	0.0	0.0	0.0	16,685.0	1
Springborn Laboratories, Inc.	367.5	10	112.5	0.0	0.0	0.0	0.0	4
St Elizabeth's Hospital	50.0	10	0.0	36.0	0.0	25.0	0.0	
St John's Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
St Joseph's Hospital	0.0		0.0	100.0	0.0	0.0	0.0	
St Luke's Hospital	0.0		0.0	125.0	0.0	0.0	0.0	
St Vincent Hospital	0.0		0.0	17.0	0.0	0.0	0.0	
Strichman Medical Equipment	0.0		0.0	3.0	0.0	1.0	0.0	
Sturdy Memorial Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Symmes Hospital	0.0		0.0	5.0	0.0	0.0	0.0	

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated^1 Prior to Disposal			Alternate Management Methods				Number of Shipments Reported
	Volume Before Treatment	Treatment Code^2	Volume After Treatment	Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	
Syncor International Corp.	0.0		0.0	230.0	0.0	0.0	0.0	
T Cell Sciences, Inc.	37.5	1, 10	8.2	3.8	0.0	0.0	9.4	4
Telesector Resources Group	10.7		10.7	0.0	0.0	0.0	0.0	2
Texas Instruments	0.0		0.0	0.0	0.0	0.0	0.0	48
Therion Biologics Corporation	0.0		0.0	4.1	0.0	0.0	0.0	
Transkaryotic Therapies, Inc.	45.0		45.0	30.0	0.0	0.0	0.0	2
TRW Fasteners Division	0.0		0.0	0.0	0.0	1.0	0.0	
TSI Center for Diagnostic Products	0.0		0.0	35.4	0.0	0.0	0.0	
TSI Mason Research Institute	105.7	2, 10	16.7	60.0	0.0	0.0	201.5	2
Tufts University	30.0	10	0.0	112.5	0.0	0.0	7.5	
Tufts University School of Medicine	570.0	1, 10	199.1	7.5	0.0	0.0	0.0	6
U.S.D.A. Human Nutritional Research Center	135.0	1, 10	45.8	0.0	0.0	0.0	0.0	5
V A Medical Center, Boston	30.0	1, 10	7.5	15.1	10.0	0.0	22.5	1
ENRM VA Hospital	41.5	2, 10	26.5	75.0	0.0	0.0	0.0	6
VA Hospital Northhampton	0.0		0.0	5.0	0.0	0.0	0.0	
Varian Associates	75.0		75.0	0.0	0.0	0.0	15.0	3
Vertex Pharmaceuticals	60.0	1, 10	22.5	40.0	0.0	0.0	0.0	1
Vicam	0.0		0.0	0.0	0.0	0.0	4.0	
WR Grace & Co.	0.0		0.0	3.0	0.0	0.0	0.0	
WR Grace & Co. Amicon Div.	15.0	1, 10	1.5	22.5	0.0	0.0	0.0	1
Wellesley College	45.0	10	0.0	30.0	0.0	0.0	37.5	
Westover AFB	0.0		0.0	0.0	0.0	0.0	0.0	1

Table A–3

Volume Summary of Treatment and Management Practices Utilized by Organizations that Produced LLRW During 1992

(cubic feet)

(continued)

Organization	Waste Treated[1] Prior to Disposal: Volume Before Treatment	Treatment Code[2]	Volume After Treatment	Alternate Management Methods: Storage For Decay	Incineration	Return to Manufacturer	Total Waste Stored On–site	Number of Shipments Reported
Whidden Memorial Hospital	0.0		0.0	18.0	0.0	25.0	0.0	
Whitehead Institute for Biomedical Research	234.2	1, 10, 14	150.0	495.0	0.0	0.0	0.0	5
Williams College	0.0		0.0	14.0	0.0	0.0	4.0	
Winchester Hospital	0.0		0.0	7.5	0.0	0.0	0.0	
Winthrop Hospital	0.0		0.0	5.0	0.0	0.0	0.0	
Woods Hole Oceanographic Institute	40.1	10	16.0	30.0	0.0	0.0	0.0	2
Vorcester Foundation for Experimental Biology	75.0	10	22.5	557.5	0.0	0.0	0.0	10
Vorcester Polytechnic Institute	4.0		4.0	4.0	0.0	0.0	0.0	1
Vyman–Gordon Company	15.7		15.7	0.0	0.0	0.0	0.0	1
ankee Atomic Electric Co.	98.4		98.4	0.0	0.0	0.0	0.0	17

[1] Treatment at out–of–state facilities.

[2] Treatment Code Legend: 1=Compaction up to 250 Tons, 2=Compaction 251–999 Tons, 3=Compaction 1000–2500 Tons, 4=Compaction above 2500 Tons, 5=Storage for decay, 9=Solidification, 10=Incineration, 11=Size Reduction\Sectioning 12=Adsorption, 14=Absorption, 18=Dry Chemical Packing

Table A–4
Ranking by Volume of Organizations that Shipped LLRW for Disposal During 1992

Organization	Volume (cuft)				% of Total	Cumulative %
	Class A	Class B	Class C	Total		
Texas Instruments	54,719.0	0.0	0.0	54,719.0	46.0	46.0
Army, Department of	32,291.2	0.0	0.0	32,291.2	27.1	73.1
Yankee Atomic Electric Co.	7,002.4	0.0	235.1	7,237.5	6.1	79.2
Nuclear Metals, Inc.	6,470.6	0.0	0.0	6,470.6	5.4	84.6
Boston Edison Co.	6,135.5	132.4	0.0	6,267.9	5.3	89.9
Du Pont Medical Products	3,580.4	97.5	127.0	3,804.9	3.2	93.1
E I. Du Pont De Nemours and Co. (o)	996.9	0.0	0.0	996.9	0.8	93.9
E I. Du Pont De Nemours and Co.	823.8	0.0	0.0	823.8	0.7	94.6
Du Pont Merck Pharmaceutical Co.	748.6	0.0	0.0	748.6	0.6	95.3
Raytheon Company (Willow St. Waltham)	500.0	0.0	0.0	500.0	0.4	95.7
Massachusetts Institute of Technology	420.0	0.0	0.0	420.0	0.4	96.0
New England Deaconess Hospital	410.7	0.0	0.0	410.7	0.3	96.4
Interstate Nuclear Services	397.5	0.0	0.0	397.5	0.3	96.7
Seragen, Inc.	342.0	0.0	0.0	342.0	0.3	97.0
Genetics Institute	300.0	0.0	0.0	300.0	0.3	97.2
SmithKline Beecham Clinical Laboratory	232.7	0.0	0.0	232.7	0.2	97.4
Tufts University School of Medicine	199.1	0.0	0.0	199.1	0.2	97.6
New England Medical Center	188.7	0.0	0.0	188.7	0.2	97.8
BASF Bioresearch Corp.	165.5	0.0	0.0	165.5	0.1	97.9
Whitehead Institute for Biomedical Research	150.0	0.0	0.0	150.0	0.1	98.0
Northeastern University	132.3	0.0	0.0	132.3	0.1	98.1
Boston College	118.3	0.0	0.0	118.3	0.1	98.2
Springborn Laboratories, Inc.	112.5	0.0	0.0	112.5	0.1	98.3
Metpath, Inc.	106.0	0.0	0.0	106.0	0.1	98.4
Boston University Medical Ctr.	104.7	0.0	0.0	104.7	0.1	98.5
Organogenesis, Inc.	94.0	0.0	0.0	94.0	0.1	98.6
Harvard University	92.8	0.0	0.0	92.8	0.1	98.7
Creative Biomolecules, Inc.	90.0	0.0	0.0	90.0	0.1	98.8
Cambridge Neuroscience Research	89.8	0.0	0.0	89.8	0.1	98.8
Brandeis University	84.1	0.0	0.0	84.1	0.1	98.9
Varian Associates	75.0	0.0	0.0	75.0	0.1	99.0
Marine Biological Laboratory	60.3	0.0	0.0	60.3	0.1	99.0
Beth Israel Hospital	60.0	0.0	0.0	60.0	0.1	99.1
ImmuLogic Pharmaceutical Corp.	52.5	0.0	0.0	52.5	0.0	99.1
Genzyme Corp.	52.5	0.0	0.0	52.5	0.0	99.1
Serono Laboratories, Inc.	50.4	0.0	0.0	50.4	0.0	99.2
U.S.D.A. Human Nutritional Research Center	45.8	0.0	0.0	45.8	0.0	99.2

Table A–4
Ranking by Volume of Organizations that Shipped LLRW for Disposal During 1992
(continued)

Organization	Volume (cuft)				% of Total	Cumulative %
	Class A	Class B	Class C	Total		
Alkermes, Inc.	45.5	0.0	0.0	45.5	0.0	99.3
Institute of Molecular Biology	45.0	0.0	0.0	45.0	0.0	99.3
Transkaryotic Therapies, Inc.	45.0	0.0	0.0	45.0	0.0	99.3
Advanced Magnetics, Inc.	38.9	0.0	0.0	38.9	0.0	99.4
Ciba Corning Diagnostics Corp. (Walpole)	30.7	0.0	0.0	[illegible].7	0.0	99.4
Biogen, Inc.	30.0	0.0	0.0	30.0	0.0	99.4
Enzytech, Inc.	30.0	0.0	0.0	30.0	0.0	99.5
PB Diagnostic Systems, Inc.	30.0	0.0	0.0	30.0	0.0	99.5
Amersham Corporation	30.0	0.0	0.0	30.0	0.0	99.5
ENRM VA Hospital	26.5	0.0	0.0	26.5	0.0	99.5
M/A–COM, Inc.	24.1	0.0	0.0	24.1	0.0	99.5
Applied bioTechnology, Inc.	22.5	0.0	0.0	22.5	0.0	99.6
Worcester Foundation for Experimental Biology	22.5	0.0	0.0	22.5	0.0	99.6
Vertex Pharmaceuticals	22.5	0.0	0.0	22.5	0.0	99.6
Repligen Corporation	22.3	0.0	0.0	22.3	0.0	99.6
Sprague Electric Co.	22.0	0.0	0.0	22.0	0.0	99.6
Health & Human Services Department of	19.1	0.0	0.0	19.1	0.0	99.7
Brigham & Women's Hospital	19.0	0.0	0.0	19.0	0.0	99.7
Smith College	18.8	0.0	0.0	18.8	0.0	99.7
Children's Hospital	17.0	0.0	0.0	17.0	0.0	99.7
TSI Mason Research Institute	16.7	0.0	0.0	16.7	0.0	99.7
Micro–Dynamics, Inc.	16.0	0.0	0.0	16.0	0.0	99.7
Woods Hole Oceanographic Institute	16.0	0.0	0.0	16.0	0.0	99.7
Wyman–Gordan Company	15.7	0.0	0.0	15.7	0.0	99.8
Boston University	15.6	0.0	0.0	15.6	0.0	99.8
Millipore Corporation (Burlington)	15.0	0.0	0.0	15.0	0.0	99.8
Arthur D. Little, Inc.	15.0	0.0	0.0	15.0	0.0	99.8
Massachusetts, University of (Medical Center)	15.0	0.0	0.0	15.0	0.0	99.8
College of the Holy Cross	15.0	0.0	0.0	15.0	0.0	99.8
Massachusetts, University of (Harbor Campus)	15.0	0.0	0.0	15.0	0.0	99.8
Massachusetts General Hospital	11.0	0.0	0.0	11.0	0.0	99.8
Telesector Resources Group	10.7	0.0	0.0	10.7	0.0	99.9
Panametrics, Inc.	2.0	0.0	7.8	9.8	0.0	99.9
Procept, Inc.	9.4	0.0	0.0	9.4	0.0	99.9
T Cell Sciences, Inc.	8.2	0.0	0.0	8.2	0.0	99.9
Mallinckrodt Medical, Inc.	8.0	0.0	0.0	8.0	0.0	99.9
Battelle Ocean Sciences	8.0	0.0	0.0	8.0	0.0	99.9

Table A–4
Ranking by Volume of Organizations that Shipped LLRW for Disposal During 1992
(continued)

Organization	Volume (cuft)				% of Total	Cumulative %
	Class A	Class B	Class C	Total		
Cellcor Therapies, Inc.	8.0	0.0	0.0	8.0	0.0	99.9
Prym\Dritz Corporation	7.5	0.0	0.0	7.5	0.0	99.9
Gene – Trak Systems	7.5	0.0	0.0	7.5	0.0	99.9
VA Medical Center, Boston	7.5	0.0	0.0	7.5	0.0	99.9
Boston City Hospital	7.5	0.0	0.0	7.5	0.0	99.9
BIOTEK, Inc.	7.5	0.0	0.0	7.5	0.0	99.9
Dana–Farber Cancer Institute	7.3	0.0	0.0	7.3	0.0	99.9
Westover AFB	0.0	7.0	0.0	7.0	0.0	99.9
AtlantiCare Medical Center	6.6	0.0	0.0	6.6	0.0	99.9
CIS–US, Inc.	6.2	0.0	0.0	6.2	0.0	99.9
General Electric Co. (Lynn)	5.1	0.0	0.0	5.1	0.0	100.0
CytoMed, Inc.	5.0	0.0	0.0	5.0	0.0	100.0
Center for Blood Research	5.0	0.0	0.0	5.0	0.0	100.0
ImmunoGen, Inc.	4.5	0.0	0.0	4.5	0.0	100.0
Worcester Polytechnic Institute	4.0	0.0	0.0	4.0	0.0	100.0
Repligen Sandoz Research Corp.	4.0	0.0	0.0	4.0	0.0	100.0
Nissin Molecular Biology Institute, Inc.	4.0	0.0	0.0	4.0	0.0	100.0
American Science & Engineering, Inc.	4.0	0.0	0.0	4.0	0.0	100.0
Liberty Mutual Insurance Co.	4.0	0.0	0.0	4.0	0.0	100.0
Crystal Diagnostics, Inc.	3.1	0.0	0.0	3.1	0.0	100.0
Eisai Research Institute	3.0	0.0	0.0	3.0	0.0	100.0
Joslin Diabetes Center	2.9	0.0	0.0	2.9	0.0	100.0
International Biotechnology Labs, Inc.	2.5	0.0	0.0	2.5	0.0	100.0
EG&G, Inc.	2.0	0.0	0.0	2.0	0.0	100.0
Eunice Kennedy Shriver Center	1.5	0.0	0.0	1.5	0.0	100.0
WR Grace & Co. Amicon Div.	1.5	0.0	0.0	1.5	0.0	100.0
Genica Pharmaceuticals Co.	1.5	0.0	0.0	1.5	0.0	100.0
New England Power Co. (Salem)	1.1	0.0	0.0	1.1	0.0	100.0
Massachusetts Eye & Ear Infirmary	1.1	0.0	0.0	1.1	0.0	100.0
Fitchburg State College	1.1	0.0	0.0	1.1	0.0	100.0
Optical Corporation of America	1.0	0.0	0.0	1.0	0.0	100.0
Oxford Analytical, Inc.	0.5	0.0	0.0	0.5	0.0	100.0
Massachusetts Dept. of Environmental Protection	0.0	<0.1	0.0	<0.1	0.0	100.0
Total	118,397.4	236.9	369.9	119,004.2		

Table A–5
Ranking by Radioactivity of Organizations that Shipped LLRW for Disposal during 1992

Organization	Radioactivity (curies)				% of Total	Cumulative %
	Class A	Class B	Class C	Total		
Du Pont Medical Products	1,552.1026	41,775.8170	24.6239	43,352.5435	56.8	56.8
Yankee Atomic Electric Co.	13.5037	0.0000	32,131.1980	32,144.7017	42.1	98.9
Boston Edison Co.	101.8002	443.2559	0.0000	545.0561	0.7	99.6
Army, Department of	76.1526	0.0000	0.0000	76.1526	0.1	99.7
Du Pont Merck Pharmaceutical Co.	67.6224	0.0000	0.0000	67.6224	0.1	99.8
E I. Du Pont De Nemours and Co.	66.6863	0.0000	0.0000	66.6863	0.1	99.9
Varian Associates	59.5658	0.0000	0.0000	59.5658	0.1	99.9
Westover AFB	0.0000	10.4800	0.0000	10.4800	0.0	99.9
M/A–COM, Inc.	9.1157	0.0000	0.0000	9.1157	0.0	100.0
New England Deaconess Hospital	6.0873	0.0000	0.0000	6.0873	0.0	100.0
Brandeis University	4.7950	0.0000	0.0000	4.7950	0.0	100.0
Nuclear Metals, Inc.	4.4029	0.0000	0.0000	4.4029	0.0	100.0
Massachusetts, University of (Medical Center)	3.9000	0.0000	0.0000	3.9000	0.0	100.0
Massachusetts Institute of Technology	1.7288	0.0000	0.0000	1.7288	0.0	100.0
Genetics Institute	1.0273	0.0000	0.0000	1.0273	0.0	100.0
E I. Du Pont De Nemours and Co. (o)	0.8079	0.0000	0.0000	0.8079	0.0	100.0
Texas Instruments	0.7650	0.0000	0.0000	0.7650	0.0	100.0
Whitehead Institute for Biomedical Research	0.6903	0.0000	0.0000	0.6903	0.0	100.0
Oxford Analytical, Inc.	0.6300	0.0000	0.0000	0.6300	0.0	100.0
Interstate Nuclear Services	0.5945	0.0000	0.0000	0.5945	0.0	100.0
Tufts University School of Medicine	0.5446	0.0000	0.0000	0.5446	0.0	100.0
Harvard University	0.5046	0.0000	0.0000	0.5046	0.0	100.0
Ciba Corning Diagnostics Corp. (Walpole)	0.4256	0.0000	0.0000	0.4256	0.0	100.0
American Science & Engineering, Inc.	0.3427	0.0000	0.0000	0.3427	0.0	100.0
Boston University Medical Ctr.	0.2914	0.0000	0.0000	0.2914	0.0	100.0
Amersham Corporation	0.2710	0.0000	0.0000	0.2710	0.0	100.0
Liberty Mutual Insurance Co.	0.2612	0.0000	0.0000	0.2612	0.0	100.0
AtlantiCare Medical Center	0.2450	0.0000	0.0000	0.2450	0.0	100.0
Worcester Foundation for Experimental Biology	0.2300	0.0000	0.0000	0.2300	0.0	100.0
Prym\Dritz Corporation	0.1900	0.0000	0.0000	0.1900	0.0	100.0
BASF Bioresearch Corp.	0.1854	0.0000	0.0000	0.1854	0.0	100.0
Cambridge Neuroscience Research	0.1850	0.0000	0.0000	0.1850	0.0	100.0
Repligen Corporation	0.1479	0.0000	0.0000	0.1479	0.0	100.0
Health & Human Services, Department of	0.1358	0.0000	0.0000	0.1358	0.0	100.0
Seragen, Inc.	0.1245	0.0000	0.0000	0.1245	0.0	100.0
Creative Biomolecules, Inc.	0.0991	0.0000	0.0000	0.0991	0.0	100.0
CIS–US, Inc.	0.0859	0.0000	0.0000	0.0859	0.0	100.0

Table A–5

Ranking by Radioactivity of Organizations that Shipped LLRW for Disposal during 1992

(continued)

Organization	Radioactivity (curies)				% of	Cumulative
	Class A	Class B	Class C	Total	Total	%
New England Medical Center	0.0703	0.0000	0.0000	0.0703	0.0	100.0
Procept, Inc.	0.0644	0.0000	0.0000	0.0644	0.0	100.0
Biogen, Inc.	0.0615	0.0000	0.0000	0.0615	0.0	100.0
Northeastern University	0.0570	0.0000	0.0000	0.0570	0.0	100.0
Marine Biological Laboratory	0.0520	0.0000	0.0000	0.0520	0.0	100.0
Panametrics, Inc.	0.0190	0.0000	0.0300	0.0490	0.0	100.0
Brigham & Women's Hospital	0.0485	0.0000	0.0000	0.0485	0.0	100.0
Beth Israel Hospital	0.0421	0.0000	0.0000	0.0421	0.0	100.0
Genzyme Corp.	0.0401	0.0000	0.0000	0.0401	0.0	100.0
Applied bioTechnology, Inc.	0.0370	0.0000	0.0000	0.0370	0.0	100.0
T Cell Sciences, Inc.	0.0333	0.0000	0.0000	0.0333	0.0	100.0
Millipore Corporation (Burlington)	0.0310	0.0000	0.0000	0.0310	0.0	100.0
Massachusetts Dept. of Environmental Protection	0.0000	0.0300	0.0000	0.0300	0.0	100.0
SmithKline Beecham Clinical Laboratory	0.0300	0.0000	0.0000	0.0300	0.0	100.0
U.S.D.A. Human Nutritional Research Center	0.0275	0.0000	0.0000	0.0275	0.0	100.0
Springborn Laboratories, Inc.	0.0271	0.0000	0.0000	0.0271	0.0	100.0
Smith College	0.0265	0.0000	0.0000	0.0265	0.0	100.0
Boston College	0.0259	0.0000	0.0000	0.0259	0.0	100.0
Institute of Molecular Biology	0.0227	0.0000	0.0000	0.0227	0.0	100.0
ImmuLogic Pharmaceutical Corp.	0.0224	0.0000	0.0000	0.0224	0.0	100.0
BIOTEK, Inc.	0.0220	0.0000	0.0000	0.0220	0.0	100.0
Gene – Trak Systems	0.0202	0.0000	0.0000	0.0202	0.0	100.0
Wyman–Gordan Company	0.0200	0.0000	0.0000	0.0200	0.0	100.0
EG&G, Inc.	0.0200	0.0000	0.0000	0.0200	0.0	100.0
Worcester Polytechnic Institute	0.0200	0.0000	0.0000	0.0200	0.0	100.0
Advanced Magnetics, Inc.	0.0189	0.0000	0.0000	0.0189	0.0	100.0
Boston University	0.0184	0.0000	0.0000	0.0184	0.0	100.0
Eisai Research Institute	0.0150	0.0000	0.0000	0.0150	0.0	100.0
ENRM VA Hospital	0.0145	0.0000	0.0000	0.0145	0.0	100.0
Enzytech, Inc.	0.0140	0.0000	0.0000	0.0140	0.0	100.0
Alkermes, Inc.	0.0103	0.0000	0.0000	0.0103	0.0	100.0
Children's Hospital	0.0087	0.0000	0.0000	0.0087	0.0	100.0
New England Power Co. (Salem)	0.0080	0.0000	0.0000	0.0080	0.0	100.0
Massachusetts, University of (Harbor Campus)	0.0065	0.0000	0.0000	0.0065	0.0	100.0
Joslin Diabetes Center	0.0060	0.0000	0.0000	0.0060	0.0	100.0
Center for Blood Research	0.0059	0.0000	0.0000	0.0059	0.0	100.0
ImmunoGen, Inc.	0.0055	0.0000	0.0000	0.0055	0.0	100.0

Table A-5
Ranking by Radioactivity of Organizations that Shipped LLRW for Disposal during 1992
(continued)

Organization	Radioactivity (curies)				% of Total	Cumulative %
	Class A	Class B	Class C	Total		
WR Grace & Co. Amicon Div.	0.0050	0.0000	0.0000	0.0050	0.0	100.0
Arthur D. Little, Inc.	0.0050	0.0000	0.0000	0.0050	0.0	100.0
Fitchburg State College	0.0050	0.0000	0.0000	0.0050	0.0	100.0
Organogenesis, Inc.	0.0046	0.0000	0.0000	0.0046	0.0	100.0
Sprague Electric Co.	0.0045	0.0000	0.0000	0.0045	0.0	100.0
Serono Laboratories, Inc.	0.0035	0.0000	0.0000	0.0035	0.0	100.0
Optical Corporation of America	0.0031	0.0000	0.0000	0.0031	0.0	100.0
CytoMed, Inc.	0.0029	0.0000	0.0000	0.0029	0.0	100.0
Metpath, Inc.	0.0026	0.0000	0.0000	0.0026	0.0	100.0
Vertex Pharmaceuticals	0.0020	0.0000	0.0000	0.0020	0.0	100.0
Nissin Molecular Biology Institute, Inc.	0.0020	0.0000	0.0000	0.0020	0.0	100.0
Boston City Hospital	0.0015	0.0000	0.0000	0.0015	0.0	100.0
Crystal Diagnostics, Inc.	0.0015	0.0000	0.0000	0.0015	0.0	100.0
Telesector Resources Group	0.0012	0.0000	0.0000	0.0012	0.0	100.0
Genica Pharmaceuticals Co.	0.0010	0.0000	0.0000	0.0010	0.0	100.0
Raytheon Company (Willow St. Waltham)	0.0010	0.0000	0.0000	0.0010	0.0	100.0
Repligen Sandoz Research Corp.	0.0009	0.0000	0.0000	0.0009	0.0	100.0
V A Medical Center, Boston	0.0008	0.0000	0.0000	0.0008	0.0	100.0
Massachusetts General Hospital	0.0008	0.0000	0.0000	0.0008	0.0	100.0
Dana-Farber Cancer Institute	0.0007	0.0000	0.0000	0.0007	0.0	100.0
Micro-Dynamics, Inc.	0.0006	0.0000	0.0000	0.0006	0.0	100.0
General Electric Co. (Lynn)	0.0006	0.0000	0.0000	0.0006	0.0	100.0
College of the Holy Cross	0.0004	0.0000	0.0000	0.0004	0.0	100.0
International Biotechnology Labs, Inc.	0.0003	0.0000	0.0000	0.0003	0.0	100.0
Woods Hole Oceanographic Institute	0.0003	0.0000	0.0000	0.0003	0.0	100.0
TSI Mason Research Institute	0.0002	0.0000	0.0000	0.0002	0.0	100.0
Eunice Kennedy Shriver Center	0.0002	0.0000	0.0000	0.0002	0.0	100.0
PB Diagnostic Systems, Inc.	0.0001	0.0000	0.0000	0.0001	0.0	100.0
Transkaryotic Therapies, Inc.	0.0001	0.0000	0.0000	0.0001	0.0	100.0
Cellcor Therapies, Inc.	0.0001	0.0000	0.0000	0.0001	0.0	100.0
Massachusetts Eye & Ear Infirmary	<0.0001	0.0000	0.0000	<0.0001	0.0	100.0
Battelle Ocean Sciences	<0.0001	0.0000	0.0000	<0.0001	0.0	100.0
Mallinckrodt Medical, Inc.	<0.0001	0.0000	0.0000	<0.0001	0.0	100.0
Total	1,977.2726	42,229.5829	32,155.8519	76,362.7074		

Table A–6

1992 Volume and Activity Shipped for Disposal – by County

(cubic feet and curies)

County	Volume	% of Total	Radioactivity	% of Total
Barnstable	76.3	0.06	0.0523	0.00
Berkshire	22.0	0.02	0.0045	0.00
Bristol	54,734.5	45.99	0.9550	0.00
Dukes	0.0	0.00	0.0000	0.00
Essex	109.3	0.09	59.9104	0.08
Franklin	7,139.1	6.00	32,144.6970	42.09
Hampden	404.5	0.34	11.0745	0.01
Hampshire	18.8	0.02	0.0265	0.00
Middlesex	44,602.7	37.48	236.0016	0.31
Nantucket	0.0	0.00	0.0000	0.00
Norfolk	111.1	0.09	0.4292	0.00
Plymouth	6,388.4	5.37	545.0832	0.71
Suffolk	5,151.9	4.33	43,360.2680	56.78
Worcester	245.6	0.21	4.2051	0.01
Total	119,004.2	100.00	76,362.7074	100.00

Appendix B: Radioactivity Information

Table B-1
Inventory of Radionuclides Contained in 1992 LLRW Shipped for Disposal
– Nuclides with less than 90 day Half-Lives
(curies)

	Half-Life	Generator Category					
Radionuclide	(days)	Acad	Comm	Govt	Health	Utility	Total
Ca-52	0.00005324	0.0050	0.0000	0.0000	0.0000	0.0000	0.0050
In-114	0.0008319	0.0000	0.0000	0.0000	0.0008	0.0000	0.0008
Ga-68	0.04708333	0.0000	0.0059	0.0000	0.0000	0.0000	0.0059
Tc-99M	0.25	1.0020	0.0001	0.0000	0.0000	0.0000	1.0021
Pb-201	0.38875	0.0000	0.0010	0.0000	0.0000	0.0000	0.0010
I-123	0.55	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
La-140	1.68	0.0000	0.0000	0.0000	0.0000	1.5300	1.5300
Pb-203	2.16	0.0000	0.0010	0.0000	0.0000	0.0000	0.0010
Y-90	2.67	0.1000	0.0422	0.0000	0.0009	0.0000	0.1431
Sb-122	2.7	0.0000	0.0005	0.0000	0.0000	0.0000	0.0005
Mo-99	2.75	0.0000	0.0123	0.0000	0.0000	0.0923	0.1046
In-111	2.8	0.1032	0.2372	0.0000	0.0000	0.0000	0.3404
Tl-201	3.04	0.1000	0.0091	0.0000	0.0000	0.0000	0.1091
Ga-67	3.26	0.5000	0.0029	0.0000	0.0000	0.0000	0.5029
Re-186	3.77	0.0000	0.4395	0.0000	0.0000	0.0000	0.4395
I-131	8.04	0.1000	3.6950	0.0000	0.0020	0.5870	4.3840
Tl-202	12.23	0.0000	3.8100	0.0000	0.0000	0.0000	3.8100
Ba-140	12.75	0.0000	0.0000	0.0000	0.0000	4.8450	4.8450
P-32	14.28	0.8293	42.8354	0.0000	0.0344	0.0000	43.6990
Rb-86	18.65	0.1035	0.0798	0.0000	0.0000	0.0000	0.1833
P-33	25.3	0.0000	0.0045	0.0000	0.0000	0.0000	0.0045
Cr-51	27.7	0.1004	3.4238	0.0000	0.0395	20.2855	23.8492
Yb-169	32.03	0.0000	0.0216	0.0000	0.0000	0.0000	0.0216
Ce-141	32.5	0.0000	0.1387	0.0000	0.0000	0.2270	0.3658
Nb-95	34.97	0.1000	0.0141	0.0000	0.0000	0.0945	0.2086
Ru-103	39.27	0.0000	0.1187	0.0000	0.0000	0.0050	0.1237
Fe-59	44.51	0.1008	0.2053	0.0000	0.0000	8.4800	8.7861
Hg-203	46.61	0.0010	0.0566	0.0000	0.0002	0.0000	0.0578
In-114m	49.51	0.0000	0.0337	0.0000	0.0035	0.0000	0.0372
Sr-89	50.52	0.0000	0.0000	0.0000	0.0000	1.2166	1.2166
I-125	60.1	0.2911	9.1062	0.0000	0.8263	0.0000	10.2235
Sb-124	60.2	0.0000	0.0000	0.0000	0.0000	0.4020	0.4020
Tc-95m	61	0.0000	0.0070	0.0000	0.0000	0.0000	0.0070
Zr-95	64.02	0.0000	0.0068	0.0000	0.0000	0.0000	0.0068
Sr-85	64.84	0.0000	0.1188	0.0000	0.0000	0.0000	0.1188
Co-58	70.88	0.1000	0.0909	0.0000	0.0000	25.3230	25.5139
Ir-192	73.83	0.1000	0.0000	0.0000	1.4206	0.0000	1.5206
Sc-46	83.81	0.0000	0.1325	0.0000	0.0020	0.0000	0.1345
S-35	87.2	1.1447	605.5196	0.0000	0.0378	0.0000	606.7021
Total		4.8810	670.1707	0.0000	2.3678	63.0879	740.5074

Table B–2

Inventory of Radionuclides Contained in 1992 LLRW Shipped for Disposal – Nuclides with Half–Lives Greater than 90 days and less than Five Years

(curies)

Radionuclide	Half–Life (days)	Generator Category					
		Acad	Comm	Govt	Health	Utility	
Sn–113	115	0.0000	0.1161	0.0000	0.0010	0.0001	0.1172
Se–75	120	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
Po–210	138	<0.0001	<0.0001	0.0000	0.0000	0.0000	<0.0001
Cm–242	163	0.0000	0.0000	0.0000	0.0000	0.0006	0.0006
Ca–45	163	0.4492	0.8055	0.0000	0.0132	0.0000	1.2679
Au–195	186	0.0000	0.0132	0.0000	0.0000	0.0000	0.0132
Gd–153	242	0.1000	1.1176	0.0000	0.0490	0.0000	1.2666
Zn–65	244	0.0020	0.5499	0.0000	0.0000	3.9340	4.4859
Ag–110m	250	0.0000	0.0916	0.0000	0.0000	12,350.0000	12,350.0916
Co–57	271	0.1003	8.3813	0.0000	0.0178	0.0001	8.4995
Ge–68	271	0.0000	0.1655	0.0000	0.0000	0.0000	0.1655
Ce–144	285	0.0000	0.0000	0.0000	0.0000	4.3413	4.3413
Mn–54	312	0.0000	0.0995	0.0000	0.0000	559.8741	559.9736
Ru–106	372	0.0000	0.0075	0.0000	0.0000	0.0000	0.0075
Cd–109	462	0.0001	0.0966	0.0000	0.0000	2,550.0000	2,550.0967
Th–228	693	0.0000	<0.0001	0.0000	0.0000	0.0000	<0.0001
Cs–134	753	0.0000	0.0929	0.0000	0.0000	9.0465	9.1394
Na–22	951	0.0097	0.3787	0.0000	0.0097	0.0000	0.3981
Pm–147	958	0.0000	0.0104	0.0000	0.0000	0.0000	0.0104
Fe–55	996	0.0011	0.9242	0.0000	0.0020	8,481.1384	8,482.0658
Sb–125	1,007	0.0000	0.0012	0.0000	0.0000	655.0000	655.0012
Tl–204	1,161	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		0.7624	12.8516	0.0000	0.0927	24,613.3352	24,627.0419

Table B-3
Inventory of Radionuclides Contained in 1992 LLRW Shipped for Disposal
- Nuclides with Greater than 5 Year Half-Lives

(curies)

	Half-Life	Generator Category					
Radionuclide	(Years)	Acad	Comm	Govt	Health	Utility	Total
Co-60	5.3	0.0435	0.8350	0.6111	0.0000	7,162.0825	7,163.5721
Eu-154	8.6	<0.0001	0.0000	0.0000	0.0000	0.0000	<0.0001
Ba-133	10.5	0.0000	0.1109	0.0000	0.0000	0.0000	0.1109
Kr-85	10.7	0.0000	40.0400	0.0000	0.0000	0.0000	40.0400
H-3	12.3	5.1915	42,761.2970	0.0000	0.4184	3.0286	42,769.9355
Eu-152	13.5	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
Pu-241	14.4	0.0000	0.0000	0.0000	0.0000	0.1742	0.1742
Cm-234/44	17.3	0.0000	0.0025	0.0000	0.0000	0.0011	0.0036
Pb-210	22.3	0.0000	0.0050	0.0000	0.0000	0.0000	0.0050
Sr-90	29.1	0.0010	1.3928	0.0000	0.0000	0.9858	2.3796
Cs-137	30.2	0.0020	0.4731	0.6111	3.6513	35.7279	40.4654
Bi-207	32.2	0.0000	<0.0001	0.0000	0.0000	0.0000	<0.0001
Pu-238	87.7	0.0000	0.0000	0.0000	0.0000	0.0014	0.0014
Ni-63	100.0	0.0300	8.5213	0.1650	0.0000	811.0028	819.7190
Ag-108	130.0	0.0000	0.2000	0.0000	0.0000	0.0000	0.2000
Am-241	432.0	0.0000	0.0529	0.0000	0.0000	0.0028	0.0557
Ra-226	1,600.0	0.3155	0.2053	0.6110	0.2450	0.0000	1.3769
C-14	5,730.0	0.3220	76.2378	0.0000	0.0437	0.3255	76.9290
Pu-239/40	6,560.0	0.0000	0.0000	0.0000	0.0000	0.0016	0.0016
Th-230	75,400.0	0.0000	0.0110	0.0000	0.0000	0.0000	0.0110
Ni-59	76,000.0	0.0000	0.0000	0.0000	0.0000	0.0006	0.0006
Tc-99	213,000.0	0.3516	0.0127	0.0000	0.0040	0.0000	0.3683
U-234	246,000.0	0.0037	0.2920	0.0000	0.0000	0.0000	0.2957
Cl-36	301,000.0	0.0202	0.0115	0.0000	0.0020	0.0000	0.0337
I-129	1.6E+07	0.0000	0.0031	0.0000	0.0000	0.0000	0.0031
U-236	2.3E+07	0.0000	<0.0001	0.0000	0.0000	0.0000	<0.0001
U-235	7.0E+08	0.0000	0.0200	0.0000	0.0000	0.0000	0.0200
U-238	4.5E+09	0.0120	5.1030	74.3198	0.0001	0.0000	79.4349
Th-232	1.0E+10	0.0010	0.0193	0.0004	0.0000	0.0000	0.0207
Total		6.2943	42,894.8460	76.3184	4.3646	8,013.3348	50,995.1581

Table B–4
Elements

Element	Symbol	Element	Symbol	Element	Symbol
Actinium	Ac	Indium	In	Samarium	Sm
Aluminum	Al	Iodine	I	Scandium	Sc
Americium	Am	Iridium	La	Selenium	Se
Antimony	Sb	Iron	Fe	Silicon	Si
Argon	Xe	Krypton	Kr	Silver	Xo
Arsenic	Os	Lanthium	La	Sodium	Na
Astatine	At	Lawrencium	Lr	Strontium	Sc
Barium	Ba	Lead	Pb	Sulfur	S
Berkelium	Ba	Lithium	La	Tantalum	Fr
Beryllium	Ba	Lutetium	La	Technetium	Fr
Bismuth	Bi	Magnesium	Mg	Tellerium	Fr
Boron	8	Manganese	Mn	Terbium	Tb
Bromine	Sc	Mendelevium	Md	Thallium	I
Cadmium	Cd	Mercury	Hg	Thorium	Th
Calcium	Cu	Molybdenum	Mo	Thulium	Tm
Californium	Cf	Neodymium	Nd	Tin	Sn
Carbon	C	Neon	Ne	Titanium	Ti
Curium	Ce	Neptunium	Na	Tungsten	I
Cesium	Ce	Nickel	Ni	Uranium	U
Chlorine	Cf	Niobium	Na	Vanadium	I
Chromium	Cr	Nitrogen	N	Xenon	Xe
Cobalt	Co	Nobelium	No	Ytterbium	Yb
Copper	Cu	Osmium	Os	Yttrium	I
Curium	Cm	Oxygen	O	Zinc	Zn
Dysprosium	Dy	Palladium	Fe	Zirconium	Zr
Einsteinium	Es	Phosphorus	P		
Erbium	Fr	Platinum	Pt		
Europium	Eu	Plutonium	Eu		
Fermium	Am	Polonium	Po		
Florine	F	Potassium	P		
Francium	Fr	Praseodymium	Pr		
Gadolinium	Gc	Promethium	Pm		
Gallium	Ga	Protactinium	Pa		
Germanium	Ga	Radium	Ra		
Gold	Au	Radon	Rn		
Hafnium	Hf	Rhenium	Re		
Helium	He	Rhodium	Rh		
Holmium	Ho	Rubidium	Rb		
Hydrogen	H	Ruthenium	Ru		

Appendix C: Survey Form Description

The annual survey form consists of 13 parts and is arranged in tabular or spreadsheet fashion with rows and columns. The parts of the form are arranged side by side, in ascending order, with 15 rows to each part. Fourteen rows are provided for waste category information, one category per row; the last row is for column totals. Each part relates to a different aspect of LLRW management.

Part I: General Information. This part requests the company or institution's license and product information as well as a signature certifying the accuracy of the information. There are two screening questions to identify users of radioactive materials that did not produce LLRW during the survey year, and those that used radioactive materials in "sealed sources," only, which encapsulate that material to prevent the generation of waste. For those categories of radioactive material users, completion of the rest of the survey is not required.

Part II: Waste Category Identification. This part requests the name of the city and county where waste is generated and a general description of the waste.

Part III: Waste Handled or Processed Off-Site By Others. This part requests the volume and radioactivity of waste that is handled by companies, known as "brokers," which arrange for the collection, transportation, treatment, storage or disposal of the LLRW, as well as "processors" who operate LLRW treatment facilities.

Part IV: Physical and Chemical Properties. This part requests information about the chemical or hazardous properties of the waste, and on-site treatment information.

Part V: Disposal Data for Wastes Shipped for Off-Site Disposal This Year. This part requests the volume of waste shipped for disposal, a physical description of the disposal container, and the NRC disposal class, and disposal site.

Part VI: Data for Wastes Placed in Storage for Future Off-Site Disposal. This part requests information, identical to Part V, for waste placed in storage, during the survey year, for future off-site disposal. Waste that may be: recycled and reused, stored for partial decay before shipment for disposal, or held for consolidation to provide more efficient shipment is to be reported in this section.

Part VII: Other Waste Management Methods Used This Year for Radioactive Materials. This part requests volume and radioactivity data on waste that was managed by methods other than land disposal.

Part VIII: Expected Waste Category Changes. Expected future changes in LLRW volume, radioactivity, and radionuclide content of the licensee's LLRW stream are requested by this part of the form.

Part IX: Total Waste Accumulated in Storage for Future Off-Site Disposal. This part requests the volume, radioactivity and predicted treatment of LLRW that has accumulated on site for future disposal.

Part X: Waste Category Termination, Decontamination, and Decommissioning Information. This part requests the volume, radioactivity, description, and predicted disposal class of waste that will be produced as a result of facility decommissioning.

Part XI: Radiological Data. This part requests the curie content of the waste, radioisotopic quantities, and radiation levels at the surface of the waste container.

Part XII: Number of Waste Shipments By Type Made in 1992. This part requests data on the type and quantity of shipments made to brokers, processors, or directly to disposal sites.

Part XIII: Waste Quantity Projections. The last part of the survey form requests generator projections of their LLRW activities for the upcoming three years.

An integral and unique part of the survey form is the classification code sheet. The sheet contains specific codes to describe characteristics of particular interest. Codes are provided for the following parameters:

(1) county in which waste is generated;

(2) waste category description;

(3) general and U. S. Environmental Protection Agency (EPA)\Massachusetts Department of Environmental Protection (DEP), treatment methods;

(4) broker\processor utilized;

(5) physical matrix;

(6) EPA\DEP hazard code;

(7) chelating agents;[8]

(8) disposal site utilized;

(9) NRC disposal classification;

(10) storage site utilized;

(11) alternate waste management methods; and

(12) NRC\U.S. Department of Transportation (DOT) waste transportation class.

The code system precludes the need to predetermine an alpha numeric code for each type of waste. Instead, waste can be described by a combination of codes thus allowing each individual waste stream to be assigned a unique code and classified, as necessary, for management purposes.

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[8] "Chelating agents" means certain organic compounds capable of forming (multiple) coordinate bonds with metals through two or more atoms of the organic compound, typically resulting in enhanced thermodynamic stability in solution and greatly altered behavior of the metal ions. Examples include amine polycarboxylic acids (e.g., EDTA, DTPA), and polycarboxylic acids (e.g., citric acid, carbolic acid, and glucinic acid). Chelating agents are used to reduce or eliminate metals from radioactively contaminated solutions.

INSTRUCTIONS **1992 LLW CLASSIFICATION SURVEY**

GENERAL INSTRUCTIONS

1. As required by M.G.L. c.111H, sec.7, any person who generates LLW in Massachusetts must annually, and at other times as requested, submit a report on such waste.

2. This survey applies to **"each person who generates, treats, stores, transports or disposes of low-level radioactive waste within the commonwealth"** (c.111H), including organizations that do not ship radioactive waste off site. Users of **SEALED SOURCE MATERIALS ONLY** must complete at least PART 1 of the survey and may not be required to complete the remainder of the survey.

3. Unless the special conditions for sealed source users specified in PART 1 apply, please read these instructions and the entire form before attempting to complete the survey.

4. If additional space is required, type or print on separate sheets of paper and attach to the Survey Form. The Survey Form or any of its pages may be reproduced for this or other purposes.

5. The Management Board must receive information from **all** radioactive materials users to plan for the broad scope of the state's LLW management needs. Therefore, it is imperative that you complete all applicable portions of this survey. Failure to do so is a violation of Massachusetts General Law, Chapter 111H and is punishable by fines ranging from one thousand to twenty thousand dollars. If you require assistance, please call (617) 727-6018.

6. Return the completed form and attachments to:

LLW Classification Survey
Commonwealth of Massachusetts
Low-Level Radioactive Waste Management Board
100 Cambridge Street, Room 903
Boston, MA 02202

This Survey must be completed and submitted no later than February 26, 1993.

SPECIFIC INSTRUCTIONS

A. Before beginning, gather your records. For shippers of radioactive waste the shipping manifest will provide a majority of the information needed to correctly complete the form including: volume, activity, and disposal class of the waste shipped for disposal. The survey format is based on a tabular "spreadsheet" style and is generally self-explanatory. However, the following guidelines and a survey form with worked examples are provided. It is recommended that the sample survey form be consulted while reviewing the instructions and the blank survey form.

B. **Step 1: Categorize the Waste.**

This is the most important step which will lead to CORRECTLY completing the form. If you are in doubt as to how to categorize your waste, contact the Management Board for assistance (617) 727-6018.

Each waste category is defined by characteristics that are the same or similar. In general, a waste category may be several containers of waste of essentially the same physical, chemical and radiological nature.

1. A waste category is defined by the following fundamental features:
   a. Same waste type - see descriptions and codes for columns 16 and 70.
   b. Same container size and type
   c. Same radioisotopic spectra
   d. Similar isotopic activity and total activity
   e. Similar radiation levels: 0-10 mR/hr, 11-200 mR/hr, 201-1000 mR/hr, 1001-10,000 mR/hr, 10,001 - 50,000 mR/hr, greater than 50,000 mR/hr.
   f. Same disposal class
   g. Presence of chelating agents, if any
   h. Same hazard code, if any
   i. Same physical matrix, if any

2. In addition, separate waste categories must be identified for any packages that contain only radionuclides with less than five year half-lives. Similar packages can be grouped into waste categories as described in (1) above and may contain more than one radionuclide with less than five year half-life.

3. **Mixed Waste**. It is important for you to identify any mixed waste being produced by your organization. Mixed waste can be identified as follows:

(1) determine if the LLW contains any listed hazardous wastes identified in the U.S. Environmental Protection Agency (EPA) regulations: Subpart D of 40 CFR Parts 261.31 through 261.33, or Massachusetts Department of Environmental Protection (DEP) regulations: 310 CMR 30.131 through 30.136.

(2) if the waste does not contain a "listed" hazardous waste under the regulations cited above, determine if the waste exhibits one of the following four characteristics pursuant to the above regulations: ignitability, corrosivity, reactivity, or toxicity.

If you are in doubt as to whether or not you have mixed waste, please contact the Management Board for assistance.

4. It may be helpful to you in establishing your waste categories if you recognize that each criteria in 1 and 2 above impact various waste management issues: processing, handling, occupational exposure, facility performance, and facility stability.

C. **Step 2: Determine the Disposition of Each Waste Category.**

1. Determine the management method for each category of waste.

2. If one category of waste was managed by more than one method, create new categories corresponding to the number of management methods. Because waste packages must be tracked with respect to waste management method, packages whose physical, chemical, and radiological characteristics were the same or similar would be assigned different categories if some where treated or handled by processors or brokers (Part III); some were shipped directly to disposal (Part V); some were stored for disposal (Part VI); some were incinerated (Part VII); or some were placed in storage in prior years (Part IX). Even though the containers were otherwise similar, a separate waste category would be established to classify those that were managed by any of the different management methods. Separate waste categories could also be required for decommissioning wastes.

D. **Step 3: Complete the form.**

1. Enter each waste category on a separate line of the survey form. Each category and management method requires a separate line.

2. For each line of the form consult the "1992 Survey Form Completion Matrix" to determine which parts of the form to complete for the management method employed for that waste category.

3. If you shipped waste for treatment prior to disposal, the values entered in columns 20 and 41 should agree and the disposal container information listed in Part V should describe the final container delivered to the disposal site. You will need to call your broker\processor for final disposal container information.

4. After reviewing the entire form, you may discover that some sections do not apply to you. The form is designed to let you skip over these sections, but you should indicate so by entering N\A at the top of the applicable section of the form.

5. Do not enter information in shaded portions of the form.

E. Part IX requests information on waste accumulated in storage for future disposal. It also requests estimates on the final volumes that will be disposed of in a licensed land disposal facility. You MUST provide a reasonable estimate of the post-storage disposal quantities and disposal classifications in columns 63-66 and its expected post storage treatment method, col. 62.

F. Part XI, Radiological Data, MUST be completed for **EACH** waste category entered in Part II through Part X. If detailed isotopic spectra are not available for Part X data, estimate quantities of principle radionuclides in Part XI.

G. Parts XII and XIII do not follow the same spreadsheet format and do not require the entry of waste category numbers and characterization data in Parts II through XI.

H. All volumes should be provided in cubic feet (ft^3). Note that a 55 gallon drum is 7.5 ft^3, a 30 gallon drum is 4.01 ft^3, and a 5 gallon container is 0.67 ft^3.

I. All quantities of radioactivity should be provided in Curies (Ci). Scientific notation is acceptable to more conveniently express very large or small numbers.

J. The choice of "Other" in selecting a characteristic code MUST be accompanied by an explanation or description.

K. Additional instructions are included at the bottom of each page of the survey form.

1992 Survey Form Completion Matrix

LLW Activity	Part(s) to Complete											
	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Shipped Directly to Disposal Site	X		X	X			X		X	X	X	X
Shipped to Third Party for Treatment Then to Disposal Site	X	X	X	X[2]			X		X	X	X	X
Storage For Decay On-Site	X					X	X		X	X		X
Placed in Storage This Year for Future Off Site Disposal	X	X[1]	X		X		X	X	X	X		X
Alternate Management Method[3]	X					X	X		X	X	X[4]	X
Waste Accumulated in Storage From Previous Years	X	X[1]	X					X		X		

[1] Complete Part III if waste is shipped to third party for treatment prior to storage.

[2] Volume reported in Part V (col. 41) should reflect final volume shipped to a disposal site from Part III (col. 20).

[3] See "code" sheet for a list of alternate management methods.

[4] Complete Part XII only if radioactive material is shipped.

CODES

Column 14
County Location

Code	Description
01	Barnstable
02	Berkshire
03	Bristol
04	Dukes
05	Essex
06	Franklin
07	Hampden
08	Hampshire
09	Middlesex
10	Nantucket
11	Norfolk
12	Plymouth
13	Suffolk
14	Worcester

Columns 16, 70
Waste Category Descriptions

Code	Description
01	Dry Active Waste - Compacted Bulk Materials (paper, plastic, glass, cloth, wood)
02	Dry Active Waste - Uncompacted Bulk Materials (paper, plastic, glass, cloth, wood, soil)
03	Dry Active Waste - Compacted Solids (wood, metal, concrete, equipment)
04	Dry Active Waste - Uncompacted Solids (wood, metal, concrete, equipment)
05	Dry Active Waste - Medical Waste (syringes, pipettes, hypodermic needles)
06	Contaminated Large Metal Objects (tanks, vessels, other large equipment)
07	Dewatered Ion Exchange Media
08	Dewatered Filter Media (powdered/granular)
09	Other Dewatered Sludges
10	Solidified Ion Exchange Media
11	Solidified Filter Media
12	Cartridge Filters
13	Other Solidified Sludges
14	Absorbed Liquids
15	Solidified Liquids
16	Liquid Scintillation Fluids/Vials - Organic (e.g., toluene, benzene)
17	Liquid Scintillation Fluids/Vials - Inorganic
18	Other Organic Liquids (Specify)
19	Incinerator Ash
20	Incinerator Ash - Solidified
21	Incinerator Ash-Agglomerated/Compressed
22	Biological Waste or Carcasses
23	Irradiated Reactor Components
24	Other Irradiated Materials
25	Gases in Sealed Containers
26	Sealed Sources
27	Contaminated Oil/Lubricant
28	Gas Filters
29	Medical Isotope Generators
30	Aqueous Liquids
31	Other (Specify)

Columns 19, 24, 62
General Treatment Methods

Code	Description
00	None
01	Compaction Up to 250 Tons
02	Compaction 251-999 Tons
03	Compaction 1000-2500 Tons
04	Compaction, Above 2500 Tons
05	Storage for Decay
06	Evaporation/Crystallization
07	Fluid Bed Drying/Calcination
08	Wet Oxidation
09	Solidification
10	Incineration
11	Size Reduction/Sectioning (shredding, cutting)
12	Adsorption
13	Macro-encapsulation
14	Absorption
15	Sorting/Segregation
16	Decontamination
17	Surface Removal (Scabbling, electropolishing, abrasive cleaning, high pressure water, strippable coatings)
18	Dry Chemical Packing (lime, etc.)
19	Other (Specify)

Column 22
Broker Utilized

Code	Description
01	Radiac
02	NDL
03	Adco
04	US Ecology
05	Chem Nuclear
06	Other (Specify)

Column 23
Processor Utilized

Code	Description
00	None
01	SEG/Westinghouse
02	Quadrex/Florida
03	Quadrex/Tennessee
04	Alaron
05	Chem Nuclear/Illinois
06	NSSI
07	Other (Specify)

Column 27
Physical Matrix

Code	Description
00	None
01	Cellulose Absorbent
02	Other Absorbent (Specify)
03	Cement
04	Cement/Silicate
05	Cement/Gypsum
06	Cement/Other
07	Bitumen
08	Solidification in Glass/Vitrification
09	Polymers (Specify)
10	Other (Specify)

Column 28, 29
Hazard

Code	Description
0000	None
D001	Ignitable
D002	Corrosive
D003	Reactive
D004	EP Toxic
thru	
D034	
----	EPA/DEP Listed Wastes (Specify EPA/DEP Code No.)
B101	Pathogenic
B102	Carcinogenic
XO	Other (Specify)

Column 30, 62
EPA/DEP Treatment Methods

Code	Description
00	None
01	Gas Absorption (ADGAS)
02	Amalgamation (AMLGM)
03	Biodegradation (BIODG)
04	Carbon Adsorption (CARBN)
05	Chemical or Electrolytic Oxidation (CHOXD)
06	Chemical Reduction (CHRED)
07	Deactivation (DEACT)
08	Fuel Substitution (FSUBS)
09	Incineration of Mercury/Organics (IMERC)
10	Incineration (INCIN)
11	Liquid-Liquid Extraction (LLEXT)
12	Macroencapsulation (MACRO)
13	Neutralization (NEUTR)
14	No Land Disposal Due to Recycling (NLDBR)
15	Chemical Precipitation (PRECP)
16	Thermal Recovery of Beryllium (RBERY)
17	Recovery/Reuse of Compressed Gases (RCGAS)
18	Recovery of Acids or Bases (RCORR)
19	Thermal Recovery of Lead (RLEAD)
20	Thermal Recovery of Mercury (RMERC)
21	Recovery of Metals (RMETL)
22	Recovery of Organics (RORGS)
23	Thermal Recovery of Metals or Inorganics (RTHRM)
24	Thermal Recovery of Zinc (RZINC)
25	Stabilization (STABL)
26	Steam Stripping of Organics (SSTRP)
27	Wet Air Oxidation (WETX)
28	Controlled Reaction With Water (WTREX)

Column 33
Chelating Agents

Code	Description
01	EDTA
02	DTPA
03	Hydroxy-carboxcylic acids
04	Citric acid
05	Carbolic acid
06	Glucinic acid
07	Other (Specify)

Column 34
Disposal Site Utilized

Code	Description
00	None
01	Barnwell, SC
02	Beatty, NV
03	Hanford, WA
04	Clive, UT
05	Other (Specify)

Columns 35, 43, 65, 66, 73, 209
USNRC/ 10CFR61
Disposal Classification System

Code	Description
00	None
01	Class A Unstable - (AU)
02	Class A Stable - (AS)
03	Class B - (B)
04	Class C - (C)
05	Greater Than Class C - (GTCC)
06	Mixed Class A Unstable - (AUH)
07	Mixed Class A Stable - (ASH)
08	Mixed Class B - (BH)
09	Mixed Class C - (CH)
10	Mixed Greater Than Class C - (GTCCH)

Columns 42, 61
Storage Site Utilized

Code	Description
01	On-site
02	Radiac
03	NDL
04	ADCO
05	Other (Specify)

Columns 53, 210
Alternate Waste Management Methods

Code	Description
01	On-Site Land Disposal
02	Out-of-State GTCC Disposal
03	Out-of-State Mixed Waste Disposal
04	Out-of-State NARM Disposal
05	Store for Decay
06	Sewer Release
07	Return to Manufacturer/Supplier
08	Recycle/Recover
09	Atmospheric Release
10	Incineration
11	Other (Specify)

Columns 202
USNRC/DOT Waste Transport Class

Code	Description
01	Low-Specific Activity
02	Type A
03	Type B
04	Highway Route Controlled Quantity

PART I
General Information

A. NRC Materials License Number(s)

B. MA Dept. of Labor and Industries NARM Registration Number(s) if you use naturally occurring or accelerator produced radioactive materials.

C. Contact Person for this Survey (please print)
Name: Title: Telephone Number:

D. Certification by Senior Operating Manager for the Licensed or Permitted Activity (please print) **SIGNATURE IS MANDATORY**
Name: Title: Telephone Number:

I certify that I have personally examined and am familiar with the information submitted in this form, and that the information contained in this form is true, accurate and complete.

Signed:____

E. Consultant Assisting with the Preparation of this Survey
Name: Telephone Number:

F. Briefly explain your use of radioactive materials (including sealed sources) and, if applicable, the activities that generate low-level waste:

G. Date Filing This Survey______________________________

H. If you only used sealed source materials, did you ship any low-level radioactive waste off-site or dispose of any radioactive materials in any other manner in 1992?
Yes________ No________

I. In 1992, did you use any radioactive materials other than sealed source material?
Yes________ No________

J. **If your answers to items "H" and "I" above are both "No", you do not have to complete the remainder of the survey form; return the completed cover page and Part I only.**

K. If you answered **"Yes"** to either item "H" or item "I", or both, complete and return all the applicable parts this survey.

Addendum I

All users of radioactive materials which produce waste now or in the future, are notified again that the federal Low-Level Radioactive Waste Policy Amendments Act of 1985 allows the three sited states (South Carolina, Nevada, and Washington) to deny access to their disposal sites.

The Management Board has arranged for 18 months (through June 30, 1994) of continued access to the Barnwell, SC. site. This access is conditional on Massachusetts making adequate progress towards arranging disposal capacity for waste generated within its borders, and could, therefore, be terminated by the Southeast Compact Commission on or prior to June 30, 1994. Extension to use the Barnwell site beyond June 30, 1994 must be arranged by a formal vote of the South Carolina Legislature. When access to the Barnwell site ceases, Massachusetts generators will be required to store their waste on site.

A. Will you be able to store your waste on-site when access to the Barnwell disposal site is terminated on or before June 30, 1994?

Yes________ No________

B. How long are you able to store your waste on site under your existing license?

____

C. How long will you be able to store your waste on site assuming appropriate license amendments are received?

____

D. Do you have the necessary NRC license amendments to store waste on site for a full five years--the current maximum allowable storage period?

Yes________ No________

E. Other than license amendments, are there any other limitations on your ability to store waste on-site (i.e. local permits, inadequate space, etc)?

____

____

____

Part II
Waste Category Identification

Waste Category Survey Number	Location Waste Generated			Waste Category Description	Waste Category Code
	Town/City	County	County Code		
11	12	13	14	15	16
92−1					
92−2					
92−3					
92−4					
92−5					
92−6					
92−7					
92−8					
92−9					
92−10					
92−11					
92−12					
92−13					
92−14					
Totals					

Instructions

- Column 11: The "Waste Category Survey" numbers in this column are intended to allow identification of distinct waste categories as defined on the Instruction sheet. These numbers are not related to code numbers provided on the code sheet.

- Column 14 and 16: Codes for all columns requiring a code are provided on the seperate code sheet included with this survey form.

- Column 15: Whenever possible, use the "Waste Category" descriptions provided on the code sheet.

- Be sure to create additional categories for discontinued waste streams in storage or for decommissioning/decontamination waste if necessary.

Part III
Waste Handled or Processed Off-Site by Others

	Waste Handled by Brokers or Processors					Broker Code	Processor Code
	Shipped to Third Party		Treatment Code(s)	To Storage/Disposal (report here and in Part V)			
	Volume (cu ft/yr)	Activity (Ci/yr)		Volume (cu ft/yr)	Activity (Ci/yr)		
	17	18	19	20	21	22	23
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
■			■			■	■

Instructions

- Columns 17 and 18: Report volumes and activities sent to broker or processor.

- Column 19: Only treatment by brokers or processors should be reported here. On-site treatment should be reported in Part IV.

- Columns 20 and 21: Report volume and activity shipped to the disposal or storage site after treatment by a broker or processor. Note: Liquid Scintillation Fluid incinerated has a final disposal volume of zero. Report Column 20 volume in Part V or VI as applicable.

- All totals for Parts III-XI should be provided in the non-shaded cells in the last row.

- Waste properties such as disposal class, volume, and activity can be found on the shipping manifest.

Part IV
Physical and Chemical Properties

	On–Site Treatment Performed				Chemical/Hazard Properties					
	Treatment Code(s)	Volume Reduction Factor	Activity Reduction Factor	Physical Matrix Code	USEPA/MASS DEP Hazard Code Before/After Treatment		Hazard Treatment Code(s)	Chelating Agents If amount > 0.1 wt %		
					Before	After		Weight %	# of Containers	Code
	24	25	26	27	28	29	30	31	32	33
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										

Instructions

- **Column 25–26: Volume and activity reduction factor refer to initial quantity divided by the final quantity.**

- **Column 27: Select a physical matrix code from the code sheet which reflects waste–form of the waste as presented for disposal or placed in storage prior to disposal.**

- **Column 28 – 29 are intended to characterize "mixed waste". Mixed Waste means low–level radioactive waste containing material that either (1) is listed as hazardous waste in 310 CMR 30.131 through 30.136 or (2) causes the low–level radioactive waste to exhibit any of the hazardous characteristics identified in 310 CMR 30.120. Column 28 and 29 apply to initial and final waste conditions whether processed on or off site.**

- **Columns 31–33 applies to packages prepared for final disposal or storage prior to disposal. Chelating agents are certain organic compounds capable of forming (multiple) coordinate bonds with metals through two or more atoms of the organic compound, typically resulting in enhanced thermodynamic stability in solution and greatly altered behavior of the metal ion. Examples of interest for LLW waste disposal include: amine polycarboxylic acids (e.g., EDTA, DTPA), hydroxylic–carboxylic acid, and**

Part V
Disposal Data for Wastes Shipped for Off–Site Disposal This Year

	Disposal Site Code	Disposal Class Code	Disposal Container Description (For waste treated by others, describe final disposal container & volume)					Total Volume (cu ft/yr)
			Type (Describe)	Dimensions (inches)	Full Weight (lbs)	Volume per Container (cu ft)	Number of Containers Shipped This Year	
	34	35	36	37	38	39	40	41
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

Instructions

- Part V requests information only for waste shipped , either directly or via a broker or processor, for disposal in a licensed off–site disposal facility. Currently such disposal facilities exist at Barnwell, SC; Beatty, NV; Hanford, Washington; and Clive, UT.

- Column 35: Disposal classes correspond to the USNRC disposal classification system promulgated in 10CFR61.

- Column 36: Specify the generic container type, e.g., "55 Gallon Steel Drum," "200 cubic foot poly HIC," etc. If waste was treated by a third party, obtain final disposal container information from that party.

- Column 39: Use standard volumes assigned by disposal sites, where possible, e.g., 7.5 cubic feet for a 55 gallon drum.

- Column 41: If waste quantities were reported in Part III, total volume reported here should correspond to volume reported as disposed of in Part III.

Part VI
Data For Waste Placed in Storage This Year for Future Off-Site Disposal

	Storage Site Code	Disposal Class Code	Disposal / Storage Container Description				Number of Containers Stored This Year	Total Volume (cu ft/yr)
			Type (Describe)	Dimensions (inches)	Full Weight (lbs)	Total Activity (Ci/yr)		
	42	43	44	45	46	47	48	49
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

Instructions

- * **Column 44: Specify the generic container type, e.g., "55 Gallon Steel Drum," "200 cubic foot poly HIC," etc.**
- * **Column 48: Totals reported here should correspond with LLW actually placed in LLW storage facilities for future disposal off-site.**

Part VII
Other Waste Management Methods Used This Year for Radioactive Materials

	Waste Stored For Decay		Other Management Methods			
	Total Volume (cu ft)	Total Activity (Ci/yr)	Description	Code Number	Total Volume (cu ft)	Total Activity (Ci/yr)
	50	51	52	53	54	55
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

Instructions

- * Provide data in this Part for radioactive effluents that are managed by methods other than off–site licensed disposal or storage for off–site licensed disposal.
- * Column 53: Use the 'Alternative Waste Management Methods' descriptions provided on the Code sheet for this column. List storage for decay quantities in columns 50 and 51 only.

Part VIII
Expected Waste Category Changes

	Volume Expected, Date Of Change And Reason For Change	Total Activity Changes	Major Radionuclide Changes
	56	57	58
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Instructions

*For existing waste categories provide quantitative information or percent changes, if possible.

*New categories expected in the future should be placed in a separate row in Part II, and appropriate data should be provided here.

Part IX
Total Accumulated Waste in Storage for Off–Site Disposal

	Total Stored Waste Volume (cu ft)	Total Activity Ci	Storage Site Code	Post Storage Treatment Planned Prior To Disposal Codes(s)	Expected Volume After Treatment (cu ft)	Expected Activity After Treatment (Ci)	Disposal Class Before/After Post Storage Treatment Code(s)		Expected Shipment Date Mo/Yr
							Before	After	
	59	60	61	62	63	64	65	66	67
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									

Instructions

- * Complete separate rows for each waste category placed in storage, including waste placed in storage this year and in prior years (add new categories for discontinued waste streams from prior years if necessary in Part II).

- * Column 60: Activity originally placed in storage may be provided unless decay values are available and so noted.

Columns 65,66: Provide the disposal classification of the waste before and after treatment.

Part X
Waste Category Termination, Decontamination, and Decommissioning Information

	Decommissioniming or Decontamination Year(s) or Expected End Date Of Waste Production	Facility Decommissioning Wastes				
		Waste Description	Waste Cat. Code	Total Volume (cu ft)	Total Activity (Ci)	Expected Disposal Class Code
	68	69	70	71	72	73
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

Instructions

*Column 68: If known or can be estimated, provide expected end–dates for this year's waste categories. Complete only Column 68 for these waste categories. For example, if you know that you will be ending the use of Liquid Scintillation Fluid in 1993, enter "1993" in column 68.

*Columns 68–73: Estimate the applicable year(s) (Column 68) and the amount of waste that would be generated as a result of the decommissioning of your facility (Columns 69–73). Create additional categories of waste and enter information on separate lines of the form, and attach additional pages if necessary. Complete the same process for decontamination wastes not included in decommissioning wastes (e.g. periodic system or facility decontamination during the licensed operating life of the facility). Be sure to create categories in Part II if necessary.

Part XI
Radiological Data

	Container Surface Radiation Levels		Columns 77–200							
			Radioisotopic Content (curies/year)							
	Range mR/HR To mR/HR	Typical mR/HR	Radio–isotopes							
			Half–Life Days							
	74	75	76							
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
			Totals							

Instructions

- * Columns 74–75: Enter radiation levels from containers that are being shipped or stored for licensed disposal. Data should reflect radiation levels on contact or less than one foot away from the package, not the reuseable shielding.

- * Columns 77–200: These columns allow for compilation of 123 different radionuclides, although this form does not provide that many columns. If more space is required, make copies of Part XI and attach to this form. List total activity in curies.

Part XI
Radiological Data

	Columns 77–200 (continued)											Total Activity (Ci/Yr)
												200
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

Part XII
Number of Waste Shipments By Type Made in 1992

201	202	203	204	205	206	207	208
Type of Shipment USNRC/DOT Shipping Classification	Transport Code	Number Of Shipments					
		Return to Supplier	Via Broker	To Processor	Returned to You From Broker or Processor	From You Directly to Disposal Site	Total Waste Shipments
LSA							
Type A							
Type B							
Highway Controlled							
Total Shipments	■						

Instructions

Instructions

* Please provide the total LLW related shipments from your facility this year. These include radioactive materials shipped to processors for various treatment.

Part XIII
Waste Quantity Projections

209	210	211	212	213	214	215	216
Radioactive Material Type	Disposal Class or Alter. Mngmt Code	Projected Waste Quantities					
		1993		1994		1995	
		Volume (cu ft)	Activity (Ci)	Volume (cu ft)	Activity (Ci)	Volume (cu ft)	Activity (Ci)
LLW Packaged for Off-Site Disposal							
Class A							
Class B							
Class C							
GTCC							
Mixed LLW							
Totals							
Materials Managed By:							
Store-for-Decay							
Other							
Other							
Other							

Instructions

- * Provide estimated waste quantities for the years indicated. These data should be consistent with information provided in Part VIII.
- * For materials managed by methods other then storage for decay, or shipment for disposal use rows marked "other" and place the appropriate code number in column 210.

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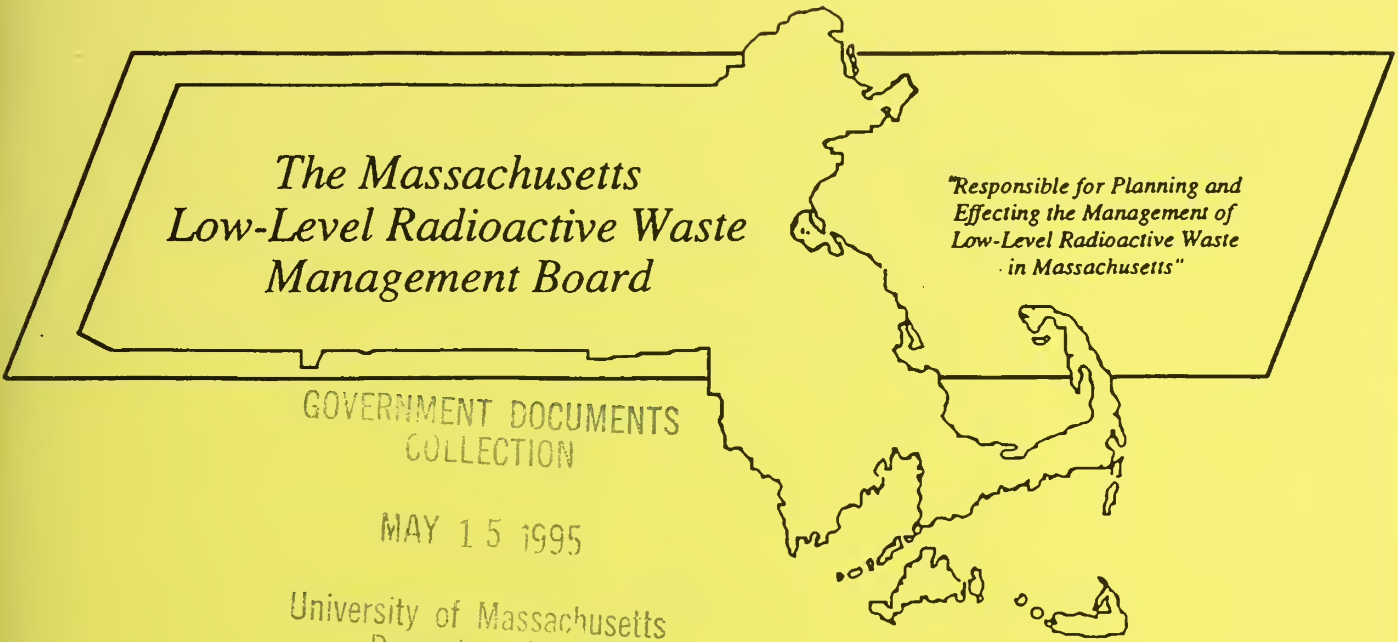

The Massachusetts
Low-Level Radioactive Waste
Management Board

"Responsible for Planning and
Effecting the Management of
Low-Level Radioactive Waste
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1993 Massachusetts Low-Level Radioactive Waste Survey Report

November 1994

1993 Massachusetts Low–Level Radioactive Waste Survey Report

November 1994

THE COMMONWEALTH OF MASSACHUSETTS
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1. Introduction

This report presents single-year radioactive waste characteristic data compiled from responses to the "1993 Low-Level Radioactive Waste Classification Survey" of radioactive materials users licensed in Massachusetts by the U. S. Nuclear Regulatory Commission (NRC) or registered by the Massachusetts Department of Labor and Industries (DLI). The report covers two broad categories of radioactive waste:

1. low-level radioactive waste (LLRW) that has been or could be disposed of in a licensed radioactive waste disposal facility; and

2. other radioactive wastes, such as liquid and gaseous wastes not included in the definition of LLRW, that are managed by other authorized methods that do not result in disposal in a licensed LLRW disposal facility.

"LLRW" is radioactive material that (1) is neither high-level radioactive waste, nor spent fuel, nor uranium mill tailings, and (2) is classified by NRC as LLRW. It does not include waste which remains a federal responsibility, such as that owned or generated by the U.S. Department of Energy, the U.S. Navy as a result of decommissioning Navy vessels, or by the federal government as a result of any research, development, testing, or production of any atomic weapon. "Other" radioactive wastes have a radioactive characteristic, but are not included in the legal definition of LLRW because various management methods authorized by the NRC, such as controlled air emissions and sewerage releases, obviates their need to be shipped to disposal facilities.

Since the Low-Level Radioactive Waste Management Board is responsible for planning and effecting the management of LLRW in the Commonwealth, the primary focus of the report is on the characteristics and management of LLRW. The survey and report track other radioactive wastes in anticipation of the Commonwealth's future status as an Agreement State[1] with the NRC, and corresponding state responsibility for monitoring and regulating many of these other radioactive wastes. The Commonwealth's responsibility, the annual survey, and this report do not cover high level waste, spent nuclear fuel, transuranic waste, or uranium mill tailings.

The annual survey is conducted to determine the characteristics of radioactive waste generated, treated, stored, released into effluents, or shipped for out-of-state disposal. The survey fulfills the requirements of M.G.L. c.111H (Chapter 111H), the Massachusetts Low-Level Radioactive Waste Management Act. Section 7 of Chapter 111H requires that each person who generates, treats, stores, transports, or disposes of LLRW within the Commonwealth shall annually provide detailed and accurate information concerning the types, volumes, radioactivity, sources, and characteristics of the LLRW produced as well as current and projected LLRW management activities, including source minimization, volume minimization, on-site storage, treatment, packaging, and transportation practices.

The annual survey enables the Management Board to formulate policy on LLRW storage, treatment, disposal, and other management activities. It also enables the Board to evaluate data in its "total hazard" classification system -- a process that categorizes LLRW not merely on the basis of its radiological characteristics (such as radioactive half-life, principal radionuclides and their concentrations present in the waste, radioisotopic quantities, etc.), but also on its chemical and biological toxicity, chemical reactivity, form, and volume.[2] This classification system is used by the Board to determine which classes of LLRW may be stored for decay,[3] which classes will require disposal, and which classes will require special management procedures to facilitate the safe and timely closure, post-closure observation and maintenance, and institutional control[4] of a facility accepting LLRW in the Commonwealth.

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[1] Massachusetts has applied to the NRC for authority to regulate users of certain radioactive materials except for federal facilities, nuclear power plants, and university research reactors, which remain under NRC control. Agreement States receive on-going training and technical support from NRC.

On February 16, 1994, the Management Board voted to initiate the process of siting an LLRW disposal facility in Massachusetts, while continuing to pursue out-of-state LLRW disposal solutions. Both in-state and out-of-state disposal options require a detailed characterization of the total waste inventory placed in a facility throughout its time of operation, and at the end of its "institutional control" period, when any LLRW that has not decayed to the "maximum concentrations above natural background levels permitted to be released into air or water in unrestricted areas under federal and state law" must be removed from the facility.[5] Annual survey results will provide a major component in projecting facility waste inventory characteristics.

1993 Survey Results Summary

During 1993, Massachusetts generators shipped 106,980 cubic feet of LLRW containing 38,070 curies of activity to out-of-state disposal facilities. The majority of waste volume shipped for disposal, 53,795 cubic feet, was Class AH[6] followed by 52,362 cubic feet of Class A, 822 cubic feet of Class B, and one cubic foot of Class C. By activity, the largest quantity shipped for disposal, 36,404 curies, was Class B followed by 1,666 curies of Class A, 0.1 curies of Class AH, and <0.001 curies of Class C. LLRW from one time site decommissioning/remediation projects had a significant impact on the quantity of waste shipped for disposal from Massachusetts during 1993. Of the 106,980 cubic feet and 38,070 curies shipped for disposal, decommissioning/remediation wastes comprised approximately 86% of the volume (92,000 cubic feet) and 45% of the activity (17,246 curies).

---

[2] An atom is comprised of a nucleus of positive and neutral particles, known respectively as protons and neutrons, orbited by negative particles called electrons. Atoms with the same number of protons are classified as elements, such as Hydrogen (1 proton) or Uranium (92 protons). Isotopes of an element are atoms containing the same number of protons but different numbers of neutrons. A "radionuclide" or "nuclide" is an unstable isotope of an element (with an unbalanced proton-to-neutron ratio) that is radioactive, meaning it will emit energy in the form of particles and/or waves (radiation) in order to change from an unstable to stable form. Every radionuclide has a defined half-life, which is the amount of time it takes for one-half of a given amount of radioactive material to decay or transform into another element, which may or may not be radioactive. The rate of transformations per second is measured in units known as curies, and is called the activity of the radioactive material. There are over 700 known nuclides (relatively few are used in commercial or medical work). See Appendix B for more information.

[3] "Storage for decay" is a common treatment procedure, and is defined in Section 2 of this report.

[4] The "closure," "post-closure observation and maintenance," and "institutional control" phases of a facility involve the time, after waste is no longer accepted at the facility (closure), when the facility operator actively monitors and maintains the facility in preparation for the transfer of the facility license from the operator to the Commonwealth (post-closure observation and maintenance), and when the Commonwealth assumes responsibility for continued facility observation, monitoring, and care (institutional control). In the case of a disposal facility, these phases could total several hundred years.

[5] This requirement is contained in Section 46 of Chapter 111H.

[6] See Section 2 for a description of LLRW disposal classes.

LLRW Generators

More than 600[7] hospitals, government agencies, biotechnology firms, and other businesses, including two nuclear power plants (one operational and another undergoing decommissioning), are licensed by NRC or registered by DLI to use or possess radioactive material in Massachusetts. Possession of an NRC license allows an organization to use source, special nuclear, or byproduct material.[8] NRC does not regulate the use of naturally-occurring or accelerator-produced radioactive materials (NARM);[9] this responsibility lies with the Commonwealth. DLI registers machines/devices that contain and processes that use or produce NARM. The most common devices registered with DLI are lead paint detectors, which use sealed sources,[10] containing the accelerator produced radionuclide Cobalt-57. DLI registrants generally do not generate LLRW since devices containing sealed sources are usually returned to the manufacturer for recycling or disposal.

Much of the information in this report is grouped by category of generator, of which there are five:

(1) Academic (Acad) - universities, colleges, and other research institutions;

(2) Commercial (Comm) - organizations such as biotechnology, engineering, and construction companies; testing laboratories; radiopharmaceutical manufacturers and suppliers; and companies using radioactive materials for process and quality control and analysis;

(3) Government (Govt) - local, state, and federal entities, such as water districts, transportation authorities, and health departments;

(4) Health - hospitals, clinics, and physicians; and

(5) Utility - companies that operate or are decommissioning nuclear power plants.

The categories listed above, while convenient for data analysis, do not acknowledge the interrelationship between them. For example, commercial organizations produce products consumed by the medical and academic communities. A common example is the case of nuclear medicine radiopharmaceuticals and radionuclides used for research. An examination of the data will reveal that organizations in the health and academic categories typically do not ship large quantities of LLRW for disposal. This situation exists because commercial companies manufacture radioisotopes from raw materials (obtained from special nuclear reactors or other devices) and deliver the final product to clinical nuclear medicine programs within the health category or academic research organizations. Any LLRW generated during the production phase is retained by the manufacturer, and hence falls within the commercial category. Although the end use of radioactive materials by hospitals and academic organizations does not generate large quantities of LLRW, the production of health-care radiopharmaceuticals and research radionuclides by commercial entities does.

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[7] The total number of radioactive materials licensees and registrants in Massachusetts varies from time to time due to the expiration or termination of some licenses and registrations, and the issuance of new ones.

[8] "Source material" means (1) uranium or thorium, or any combination thereof, in any physical or chemical form, or (2) ores which contain by weight 0.05% or more of uranium or thorium. "Special nuclear material" means plutonium, Uranium-233, uranium enriched in the isotopes 233 or 235, and any other material which the NRC determines to fit this category. "Byproduct material" is radioactive material yielded in or made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear materials and tailings or waste produced by the extraction or concentration or uranium or thorium from any ore processed primarily for its source material.

[9] "NARM" includes material which exists naturally in the environment or is produced by particle accelerators. Radium, which is used in watch dials, is an example of a naturally occurring radionuclide. Gallium-67, used in medical diagnosis, is an example of an accelerator-produced radionuclide.

[10] See Transfer to an Authorized Recipient in Section 2 for a description of sealed sources.

LLRW is generated as a by-product of various uses of radionuclides. Typical applications include:

(1) medical procedures such as cancer and thyroid dysfunction diagnosis and treatment, radioimmunoassay, and diagnostic imaging examinations;

(2) research and development in the life-science and biotechnology industry for the treatment and prevention of various diseases and medical dysfunctions, and in the environmental field to study the effects of chemicals on plant and aquatic life, and for ocean studies;

(3) commercial uses such as within instruments that measure level, thickness, and density or that are used in moisture analysis and quality control; sealed sources that are used for industrial radiography of pressure vessels and other structural welds; smoke detectors and exit signs in buildings and commercial aircraft;

(4) university education and research in medicine, materials science, and biotechnology; and

(5) the production of electricity by a nuclear power plant.

LLRW takes a variety of forms and includes: radioactively contaminated dry, solid wastes such as wood, clothing and metal; concentrates from evaporation processes; hardware that has been irradiated as a result of proximity to certain nuclear radiation sources; filters and filter media used in purifying various process streams; ion exchange resins used in water purification and chemical extraction processes; contaminated aqueous and organic liquids used in various analytical procedures and decontamination processes; contaminated used oils from machinery and processes that use radioactive materials; contaminated soil and rubble from the decommissioning and remediation of various facilities; biological waste such as animal carcasses and tissues from biological and medical research and medical diagnosis and treatment; and sludges from various processes.

Just as the physical form of LLRW varies, so does its concentration of radioactive material and energy of radiation emitted. The majority of waste generated in Massachusetts contains only trace amounts of radionuclides that emit low energy radiation. A small percentage of waste, however, typically produced by nuclear power plants and manufacturers of sealed sources, contains radionuclides that emit high energy radiation. Types of LLRW materials that typically comprise the waste stream in Massachusetts, the categories of generators producing each type, frequently used treatment processes, and the kinds of containers used for storage and disposal are summarized in Table 1. More information can be found in Section 11: Evaluating the 1993 Data for Policy-Making Purposes.

Table 1
Typical LLRW Categories, Treatment, and Packaging

Waste Category	Generator Categories Typically Producing Waste[1]	Typical Treatment Used	Typical Storage and/or Disposal Containers[2]
Dry Active Waste (DAW) (Uncompacted) metal, concrete, wood, hardware	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	none, decontamination, segregation, sorting, recycle, decay	55 & 30 gallon steel drums, steel boxes
Dry Active Waste (DAW) (Compacted) paper, cloth, clothing, glassware, plastic	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	compaction, incineration, segregation, sorting, decay	55 & 30 gallon steel drums, steel boxes, steel cargo vans, plastic boxes
Evaporator Concentrates	UTILITY	evaporation, solidification w/cement or polymers	55 gallon steel drums, steel liners[3]
Cartridge Filters for Liquids	ACADEMIC, UTILITY	none, dewatering, solidification w/cement or polymers	55 & 30 gallon steel drums, steel boxes, HIC[4]
Granular/Fiber Filter Media for Liquids	COMMERCIAL, UTILITY	dewatering to < 0.5% free water by volume	55 gallon steel drums, steel liners, HIC
Activated Hardware control rods, in-core instruments, structural materials	ACADEMIC, UTILITY	size reduction	55 gallon steel drums, steel liners, HIC
Contaminated Hardware	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	none, decontamination, decay	55 & 30 gallon steel drums, steel boxes
Ion Exchange Resins (Solidified)	COMMERCIAL, UTILITY	solidification w/cement or polymers	55 gallon steel drums, steel liners, HIC
Ion Exchange Resins (Dewatered)	COMMERCIAL, ACADEMIC, UTILITY	dewatering to < 0.5% free water by volume	55 gallon steel drums, steel liners, HIC
Contaminated Aqueous Liquids	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT	solidify, decay, sewerage disposal[5]	55 & 30 gallon steel drums
Contaminated Oils	COMMERCIAL, UTILITY	incineration, solidification, absorption	55 & 30 gallon steel drums, steel liners
Other Contaminated Organic Liquids	COMMERCIAL, ACADEMIC, HEALTH, GOVERNMENT, UTILITY	encapsulation as absorbed, incineration, decay	Incinerated or stored in 55 & 30 gallon steel drums
Contaminated Rubble, Soil, Sand, etc.	COMMERCIAL, ACADEMIC	none	55 & 30 gallon steel drums, steel boxes, HIC
Biological Waste carcasses, tissue	COMMERCIAL, ACADEMIC, HEALTH	incineration, double containers with absorbents and lime	55 & 30 gallon steel drums, steel boxes, HIC
Depleted Uranium Sludges and Metals	COMMERCIAL	recycling, solidification	55 gallon steel drums, steel boxes

Notes: (1) Not all waste streams, processes, or containers appear in a given year or from a specified generator category each year.

(2) Other containers used less frequently include small steel pails or cans in the 1/2 to 5 gallon size and 9 to 10 cubic feet fiber drums used as temporary containment vessels prior to processing, such as incineration (where the fiber drum is incinerated also).

(3) "Steel liners" are typically large cylindrical vessels ranging in capacity from 50 to 215 cubic feet.

(4) HIC means High Integrity Container, designed to withstand the effects of disposal for a minimum of 300 years.

(5) NRC regulations (10 CFR 20) permit the discharge into sanitary sewerage systems of liquids, generated incidental to operations, containing minute concentrations of certain radionuclides.

State by State Comparison

The following data from the U.S. Department of Energy (DOE) shows how Massachusetts compared to other states in 1993 with regard to volume and activity of operational LLRW shipped for disposal. The

DOE data does not include LLRW shipped from any state to the Envirocare facility in Clive, Utah, (to which Massachusetts shipped 79,372 cubic feet and 0.776 curies in 1993) since it only accepts waste from decommissioning/remediation projects.

Table 2
1993 Volume and Activity Shipped for Disposal-by State

State	Volume (cuft)	Activity (curies)	State	Volume (cuft)	Activity (curies)
Oregon	99,827.91	33.56	Ohio	6,677.14	2,370.30
Tennessee	84,657.53	242.67	Utah	6,523.50	0.35
Virginia	72,522.04	3,304.79	Minnesota	5,056.68	1,449.65
Illinois	66,514.86	37,718.31	Vermont	4,632.92	739.80
New York	51,622.61	41,642.86	Missouri	3,189.32	444.13
Pennsylvania	48,623.56	84,346.95	Arkansas	2,889.96	4,859.67
Washington	38,690.47	1,078.34	Kansas	2,726.39	1,440.23
Colorado	38,658.90	30,006.56	Army outside U.S.	2,505.50	20.01
North Carolina	37,028.21	2,502.42	Hawaii	2,361.47	2.93
South Carolina	35,476.27	20,942.55	Wisconsin	2,225.38	345.09
Massachusetts	**24,964.07**	**18,011.84**	Iowa	2,007.36	51,341.87
New Jersey	21,077.19	8,586.93	Indiana	967.15	6.75
California	19,804.41	10,914.48	Delaware	499.91	45.08
Connecticut	14,602.00	5,378.42	Kentucky	468.28	514.10
Georgia	13,232.26	218,851.17	Alaska	447.30	<0.10
Alabama	13,077.00	67,948.69	Idaho	324.00	2.12
Florida	12,526.77	13,052.40	Oklahoma	195.42	623.37
Nebraska	11,767.95	1,063.39	West Virginia	26.83	5.53
Maryland	11,364.00	5,019.37	New Mexico	12.10	<0.10
Texas	9,801.40	6,605.34	South Dakota	8.80	<0.10
Arizona	8,152.62	680.37	North Dakota	3.90	17.61
Mississippi	7,371.76	493.33	Dist. of Columbia	0.40	<0.10
Louisiana	7,161.02	255.27	Total	792,274.52	642,908.60

1993 Survey Report Contents

The annual LLRW classification survey requests information regarding LLRW disposal practices for the survey year and projections for the next three years. Section 2 defines and explains methods utilized for management of all radioactive wastes. Sections 3, 4, and 5 respectively summarize all radioactive waste, LLRW, and other radioactive waste management data. Sections 6, 7, 8, and 9 provide detailed information on the characteristics of all radioactive, LLRW, mixed LLRW, and other radioactive waste. Section 10 provides LLRW shipment information. Section 11 summarizes data on LLRW shipped for disposal, including historical quantities, source and waste volume minimization, radiological characteristics, impact of radioactive decay, and future projections. Information on waste producers and activity can be found in the appendices. Tables and figures in this report present values rounded by standard methods, and totals may not equal 100 percent. Requests for data summaries or presentations not included in this report should be directed to the Massachusetts Low-Level Radioactive Waste Management Board, 100 Cambridge Street, Room 903, Boston, MA 02202 (Telephone (617) 727-6018).

2. Radioactive Waste Management Methods

As mentioned in the introduction, this report presents data on two broad categories of radioactive waste: LLRW and other radioactive wastes managed by authorized methods. As noted, the term radioactive waste as used in this report bounds both categories.

Radioactive materials licensees are regulated by the NRC under Title 10 of the Code of Federal Regulations (CFR). Several of the Chapters (known as Parts) of Title 10 are referenced in this report. Part 20 of Title 10 (10 CFR 20) pertains to standards to protect against radiation hazards; Part 35 (10 CFR 35) pertains to medical uses of byproduct material; Part 61 (10 CFR 61) pertains to land disposal of radioactive waste,[11] and Part 71 (10 CFR 71) regulates packaging and transportation. Terms frequently used in this report to describe various operations pursuant to the above regulations are defined below.

LLRW Management

Eliminated by treatment refers to the negative change in LLRW volume that occurs due to processing, either on or off-site, prior to delivery to a licensed disposal facility. Typical treatment processes employed include: compaction, incineration, and decontamination. LLRW remaining after treatment is repackaged and shipped to a licensed disposal site. Some organizations perform compaction and incineration on-site, although most LLRW generators ship their waste out of state for treatment.

Incineration for disposal refers to a procedure whereby certain LLRW waste streams, with low specific activity and volatile radionuclides, are incinerated. 10 CFR 20 allows disposal via incineration of specific quantities of radioactivity and certain waste forms. Waste forms allowed to be incinerated are animal carcasses (used for research) and combustible liquid scintillation fluids (see mixed waste management, below). Regulations limit the specific activity of this waste to 0.05 microcuries per gram of material. Since the radionuclides allowed to be disposed of by this method[12] typically end up in gaseous compounds following incineration, the majority of radioactivity within the waste is entrained and released to the atmosphere via combustion gas. Since responsibility for disposal of any residual radioactive material is assumed by the processor, from a generator standpoint, it is a final disposal method.

It is also possible for a licensee to incinerate for disposal different waste forms, such as dry active wastes, etc., by petitioning for a specific NRC license amendment. To receive such an amendment, the licensee must show that potential doses to workers or members of the public will be within 10 CFR 20 radiation protection standards.

Storage for decay refers to a procedure in which LLRW with a relatively short half-life is held for natural radioactive decay in compliance with applicable federal and state regulations. At the end of the storage period, the waste effectively is no longer radioactive and, after radiation monitoring, it can be disposed of as normal trash. Massachusetts Law (Chapter 111H) defines storage for decay as a treatment method. Storage for decay is practical for LLRW that contains radionuclides with relatively short half-lives. Regulations require waste to be held for at least ten half-lives prior to disposal. At the conclusion of the storage period, the waste is monitored or checked to insure that it is no longer radioactive prior to disposal as non-radioactive trash. It is common practice for decayed waste to be incinerated as trash after the storage for decay period.

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[11] The NRC's Part 61 regulations were developed at a time when simple landfilling was accepted practice for managing LLRW. All of the LLRW disposal sites at the time were landfill sites, and NRC regulations were designed to enhance earlier LLRW landfilling activities. (For example, the Part 61 regulations prohibited the old and environmentally unsound practice of packaging LLRW in cardboard containers.) In contrast, Massachusetts law prohibits landfilling of LLRW, and requires that disposal facilities allow continuous monitoring and waste retrieval, if necessary. Therefore, an LLRW disposal facility in Massachusetts would not be a "shallow land burial" site, nor a "landfill," nor a "dump." It would have engineered barriers such as vaults within a warehouse building. Modern "near surface disposal" technology also utilizes various types of engineered barriers.

[12] Hydrogen-3 (H-3), also known as tritium, and Carbon-14 (C-14).

Each NRC license specifies the physical half-life of radionuclides that may be stored for decay by the generator. Typically, NRC will authorize storage for decay of radionuclides with less than 90-day half-lives. Since many radionuclides used by licensees in Massachusetts have half-lives less than 90 days, storage for decay is a common practice. Because of the presence of radionuclides with longer half-lives in nuclear power LLRW and the difficulty in segregating them from short-lived radionuclides, nuclear power plants do not store LLRW for complete decay.

Storage for future disposal refers to LLRW, generated during 1993, being held in storage, either on or off site, pending future disposal. Volume reported as stored may not reflect the final disposal volume, since the waste may be treated prior to disposal. Waste is commonly held on site for consolidation prior to shipment, for partial radioactive decay, or if disposal capacity is not available.

Total accumulated LLRW volume or activity in storage refers to LLRW generated prior to and during 1993 being held in storage, pending future disposal.

Volume or activity shipped for disposal represents LLRW shipped direct, or via a processor, to a licensed land disposal facility. Disposal facilities available during 1993 were: Barnwell, South Carolina; Clive, Utah; and Hanford, Washington. Volume and activity information is also given by "disposal class," which refers to the concentration-based (curies per cubic meter) NRC disposal classification system contained in 10 CFR 61. Four classes of waste are defined:

Class A wastes are characterized by their low concentrations of long-lived radionuclides and concentrations of short-lived radionuclides that will decay to acceptable levels within a 100-year institutional control period when a disposal facility is actively maintained after closure. These concentration limits, specified in 10 CFR 61, have been calculated on the basis of dose limits to an individual who might inadvertently intrude, occupy the disposal site, and encounter waste after this time.

Class B wastes are the next level of wastes that could represent a potential hazard to an inadvertent intruder, without additional protective measures, since they contain higher concentrations of short-lived and long-lived radionuclides. They must meet the NRC's minimum stability requirements so that the waste forms or containers can "maintain gross physical properties and identity, over 300 years" (10 CFR 61.7(b)(2)), thus limiting the exposure to a potential intruder.

Class C wastes are wastes that, due to their greater concentrations of long-lived or short-lived radionuclides, must meet more stringent waste form requirements to ensure stability, and must be disposed of in such a way to protect the inadvertent intruder for a longer period of time. These wastes must meet the stability requirements for form or container (300 years) and must be disposed of in a manner which protects against inadvertent intrusion for at least 500 years (10 CFR 61.7 (b)(5)).

Greater than Class C (GTCC) wastes are wastes whose larger concentrations of radionuclides make them unacceptable for near-surface land disposal, unlike classes A, B, and C. GTCC wastes continue to be the responsibility of the federal government.

The NRC disposal classification system is a concentration-based approach to limiting the type and quantity of radionuclides within radioactive waste classified as LLRW, so it can be managed by near-surface land disposal systems. Radioactive waste that meets the concentration limits of 10 CFR 61 is termed low-level because it contains lower concentrations of long- and short-lived radionuclides as compared to spent nuclear fuel, which is termed high-level. High-level radioactive wastes (HLRW), like GTCC wastes, contain concentrations of long- and short-lived radionuclides that make them unsuitable for management by near-surface disposal. HLRW and GTCC wastes remain the responsibility of the federal government, and the present federal strategy for HLRW management is deep geologic disposal. While the classification system does allow long-lived radionuclides in LLRW that may also appear in HLRW, their concentrations within Classes A, B, and C are such that the potential radiation dose to members of the public will be acceptably low and within the limits of 10 CFR 61.

Mixed LLRW Management

Mixed waste is radioactive material that is contaminated by, or exhibits the characteristics of, toxic chemical hazardous material, as defined by both the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP). In Massachusetts, mixed waste is classified using the same NRC disposal classifications listed above with the addition of an H for hazardous after the classification letter (i.e., Class AH, Class BH, etc.).

Disposal options for mixed waste are limited and depend upon waste source or radionuclide concentration. One option is the Clive, Utah facility; however, this site only accepts very low concentrations of activity in high volumes, such as certain decommissioning and site remediation waste (i.e., building rubble and soils). Therefore it is not an option for routinely generated process waste. Another option is incineration for disposal, although this option is limited to certain low specific activity wastes as outlined above. Mixed waste that cannot be disposed of by these options must be stored on site.

Management of Other Radioactive Wastes

As noted, information collected in the annual survey on the management methods for other radioactive wastes is supplied by generators on a voluntary basis. Because some generators of this waste decline to volunteer information to the Management Board, data on other radioactive wastes may not be complete and should be interpreted accordingly.

Atmospheric release is the discharge of radioactive gases into the air in accordance with standards set in 10 CFR 20.1302.

Sewerage release is the discharge of aqueous liquids into sanitary sewerage systems. Material discharged into sanitary sewers, as allowed by 10 CFR 20, must be a readily soluble liquid or a dispersable biological material in water (10 CFR 20.2003(a)(1)). Strict concentration limits must be observed so that proper dilution takes place.

Transfer to an authorized recipient (10 CFR 20.2006) is the shipment to another licensee of radioactive materials for disposal or recycling. Typically materials returned for disposal or recycling are sealed sources." A sealed source is radioactive material encapsulated in a non-radioactive metal shell (like steel) that prevents the release of radioactive contamination to the environment. The shell allows radiation to be emitted so it can be used for various controlled purposes, such as the inspection of pipe welds or within instruments. A sealed source is usually returned to the supplier when, due to radioactive decay, the amount of energy being emitted is no longer useful.

3. Summary of 1993 Radioactive Waste Management Data

The Management Board survey was mailed to all companies and institutions licensed by NRC and registered by DLI as of December 1993 to possess sources of ionizing radiation that involve the use of radioactive materials within the Commonwealth. The total number of organizations surveyed was 652. This section summarizes radioactive waste management activities from all survey responses according to the two categories LLRW and other radioactive wastes.

As illustrated by Table 3, of those surveyed, 261 (40.0%) indicated their use of radioactive materials resulted in the production of radioactive waste; the remainder used sealed sources or did not possess radioactive materials during 1993. Of the 261 licensees that produced radioactive waste, 78 indicated they had shipped waste to one of the two licensed disposal facilities; the remainder managed their waste by methods such as storage for decay, and did not ship LLRW for disposal. Some generators managed their waste by a combination of methods, including shipment for disposal, storage for decay, etc.

Table 3
1993 Licensee Radioactive Waste Management Summary – by Generator Category
(number of organizations)

	Acad	Comm	Govt	Health	Utility	Total	% of Total
Produced Radioactive Waste	34	129	6	90	2	261	100.0
LLRW Management							
Eliminated by Treatment (off–site)	6	17	0	3	2	28	10.7
Eliminated by Treatment (on–site)	11	24	0	3	1	39	14.9
Incineration for Disposal (off–site)	15	33	0	13	0	61	23.4
Incineration for Disposal (on–site)	2	1	0	2	0	5	1.9
Shipped for Disposal	13	52	2	9	2	78	29.9
Storage for Decay (off–site)	0	7	0	1	0	8	3.1
Storage for Decay (on–site)	30	69	3	84	0	186	71.3
Storage for Future Disposal	8	47	2	6	0	63	24.1
Other Waste Management							
Atmospheric Release	0	4	0	0	0	4	1.5
Sewerage Release	14	51	1	11	0	77	29.5
Transfer to an Authorized Recipient	2	15	3	26	0	46	17.6

Note: Column percentages total >100% since some organizations used more then one management method.

During 1993, Massachusetts produced 947,043 cubic feet, containing 57,179 curies, of radioactive waste, of which:

- 170,736 cubic feet of LLRW (18.0%), containing 14,408 curies, were managed by methods not resulting in shipment for disposal;
- 106,980 cubic feet (11.3%) of LLRW containing 38,070 curies were shipped for disposal; and
- 669,327 cubic feet (70.7%) of other radioactive wastes, containing 4,702 curies of activity, were managed by methods other than shipment for disposal.

Tables 4 and 5 and Figure 1 illustrate the quantities of radioactive wastes produced and how they were managed by each generator category.

Table 4
1993 Radioactive Waste Volume Production Summary – by Generator Category
(cubic feet)

	Acad	Comm	Govt	Health	Utility	Total	% of Total
Produced	12,439.2	755,468.5	57,165.1	24,657.7	97,312.6	947,043.1	100.0
LLRW Management							
Eliminated by Treatment (off–site)	231.6	19,906.0	0.0	167.6	79,595.4	99,900.6	10.5
Eliminated by Treatment (on–site)	2,178.5	13,676.4	0.0	367.5	1,020.0	17,242.4	1.8
Incineration for Disposal (off–site)	1,103.6	1,234.7	0.0	2,528.9	0.0	4,867.2	0.5
Incineration for Disposal (on–site)	11.2	0.4	0.0	45.6	0.0	57.2	0.0
Shipped for Disposal	377.0	32,449.5	57,106.6	349.6	16,697.2	106,979.8	11.3
Storage for Decay (off–site)	0.0	196.6	0.0	277.5	0.0	474.1	0.1
Storage for Decay (on–site)	7,496.9	15,902.8	38.9	19,849.7	0.0	43,288.3	4.6
Stored in 1993 for Future Disposal	134.1	4,555.4	12.4	204.9	0.0	4,906.7	0.5
LLRW Management Total	11,533.0	87,921.7	57,157.8	23,791.2	97,312.6	277,716.2	29.3
Other Management							
Atmospheric Release	0.0	9,028.7	0.0	0.0	0.0	9,028.7	1.0
Sewerage Release	877.1	657,133.8	2.1	438.8	0.0	658,451.9	69.5
Transfer to an Authorized Recipient	29.1	1,384.3	5.2	427.7	0.0	1,846.2	0.2
Other Management Total	906.2	667,546.8	7.3	866.5	0.0	669,326.8	70.7

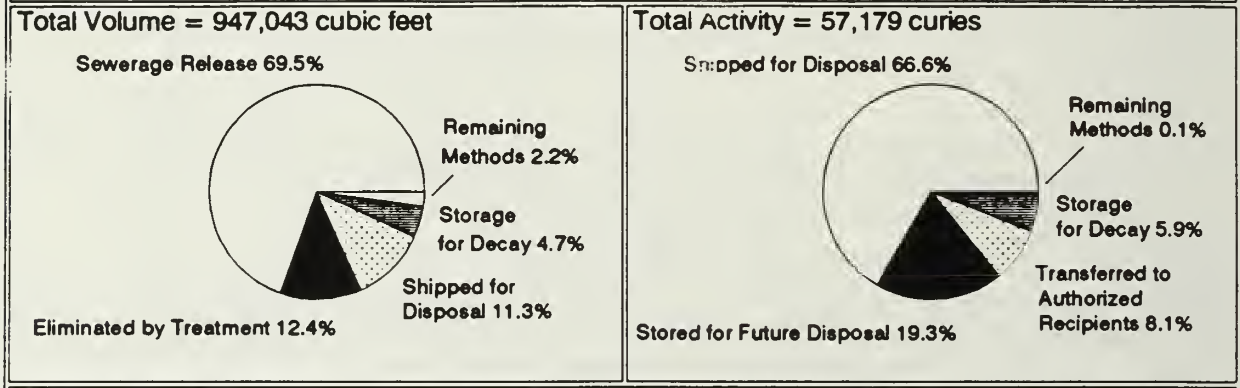
Table 5
1993 Radioactive Waste Activity Production Summary – by Generator Category
(curies)

	Acad	Comm	Govt	Health	Utility	Total	% of Total
Produced	3,253.728	33,216.185	6.877	2,881.841	17,820.507	57,179.139	100.0
LLRW Management							
Incineration for Disposal (off–site)	2.064	0.107	0.000	2.934	0.000	5.105	0.0
Incineration for Disposal (on–site)	0.172	0.004	0.000	0.040	0.000	0.216	0.0
Shipped for Disposal	11.747	20,234.065	0.615	3.054	17,820.507	38,069.988	66.6
Storage for Decay (off–site)	0.000	0.338	0.000	0.055	0.000	0.393	0.0
Storage for Decay (on–site)	26.461	557.084	0.041	2,780.628	0.000	3,364.214	5.9
Storage for Future Disposal	0.640	11,035.674	0.000	1.281	0.000	11,037.596	19.3
LLRW Management Total	41.084	31,827.272	0.656	2,787.993	17,820.507	52,477.513	91.8
Other Management							
Atmospheric Release	0.000	33.630	0.000	0.000	0.000	33.630	0.1
Sewerage Release	1.544	3.249	0.011	3.185	0.000	7.989	0.0
Transfer to an Authorized Recipient	3,211.100	1,352.034	6.210	90.663	0.000	4,660.007	8.1
Other Management Total	3,212.644	1,388.913	6.221	93.848	0.000	4,701.626	8.2

As illustrated by Figure 1, the largest percentage of radioactive waste volume produced, 69.5%, was low activity concentration liquids (see Table 5) managed by disposal into sanitary sewerage systems. The second largest portion of waste volume produced (12.4%) was LLRW volume eliminated by treatment prior to shipment for disposal. 11.3% of the volume produced was LLRW shipped for disposal either direct or via processors. LLRW that could be managed by storage for decay accounts for the fourth largest amount of volume produced (4.7%). The remaining waste management practices, including incineration for disposal, storage for future disposal, and transfer to an authorized recipient, accounted for management of a much smaller percentage of 1993 volume produced.

Figure 1 also illustrates the disposition of 1993 radioactive waste activity produced, by management method. The largest percentage of activity (66.6%) was managed by disposal in out-of-state facilities. Storage for future disposal was used to manage the second largest portion of the waste activity (19.3%), followed by transfer to an authorized recipient (8.1%), and storage for decay (5.9%). The remaining management methods handled a much smaller amount of activity.

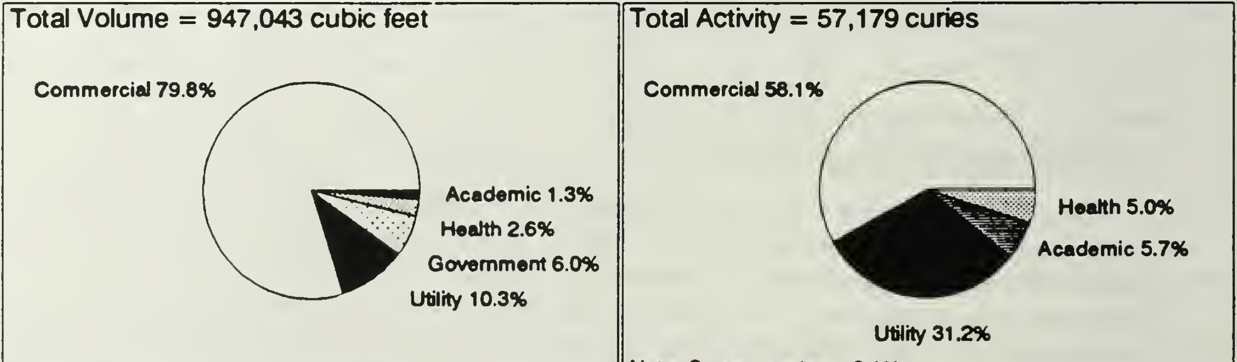
Figure 1
1993 Radioactive Waste Volume and Activity Produced – by Management Method
(percent)



Note: "Remaining Methods" = Total of other management methods listed on Table 4 or 5, but not shown on the pie chart.

Figure 2 provides a breakdown of radioactive waste volume and activity production by generator category. By volume, the largest contribution (79.8%) is from the commercial category, followed by 10.3% from the utility category, with the remainder from government (6.0%), health (2.6%), and academic institutions (1.3%). By activity, the largest contribution (58.1%) is also from the commercial category, followed by 31.2% from the utility category, and the remaining 10.7% from the health, academic, and government categories.

Figure 2
1993 Radioactive Waste Volume and Activity Produced – by Generator Category
(percent)



Note: Government = <0.1%

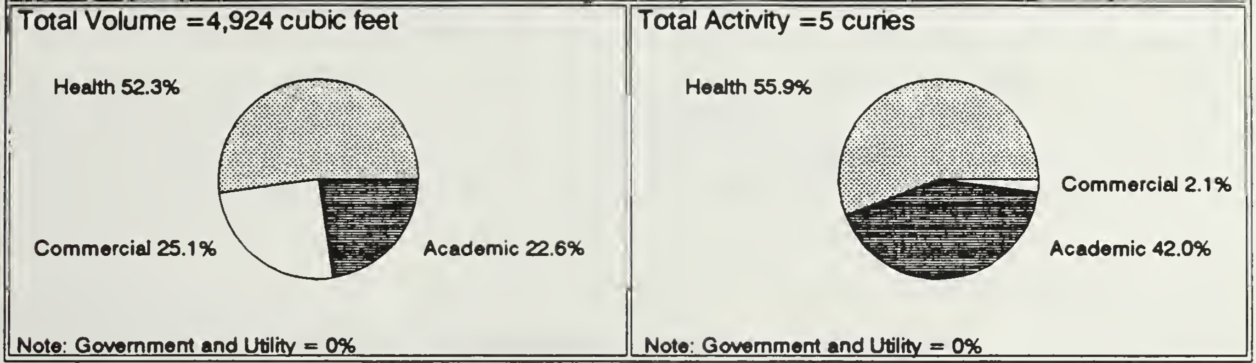
4. Summary of 1993 LLRW Data

Tables and figures in this section summarize management methods used for LLRW. Data are presented on LLRW incinerated for disposal, stored for decay, stored for future disposal, and shipped for disposal.

LLRW Incineration for Disposal Summary

During 1993, five organizations reported that they incinerated LLRW for disposal on their premises, and 61 organizations reported shipping LLRW off–site for incineration. On–site incineration for disposal represented 1.1% of the total Massachusetts LLRW incinerated for disposal in 1993. Figure 3 illustrates the total amount of LLRW incinerated for disposal by generator category.

Figure 3
1993 LLRW Volume and Activity Incinerated for Disposal – by Generator Category
(percent)



Total Volume =4,924 cubic feet

Note: Government and Utility = 0%

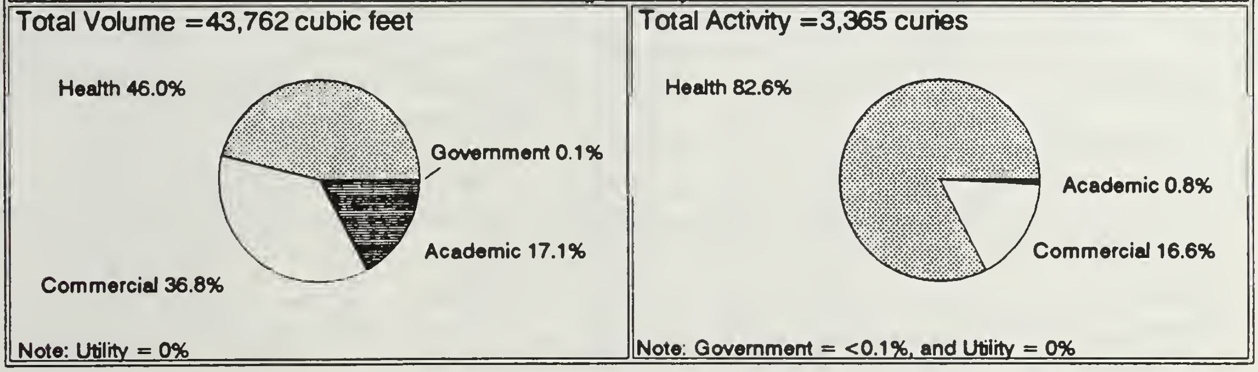
Total Activity =5 curies

Note: Government and Utility = 0%

LLRW Storage for Decay Summary

During 1993, 186 organizations reported that they stored 43,288 cubic feet of LLRW on their premises for decay. Seven organizations stored 474 cubic feet of LLRW for decay at off–site broker/processor facilities, due to lack of space at their own facilities. Figure 4 illustrates the total amount of volume and activity held in storage for decay on and off site by each generator category.

Figure 4
1993 LLRW Volume and Activity Managed by Storage for Decay – by Generator Category
(percent)



Total Volume =43,762 cubic feet

Note: Utility = 0%

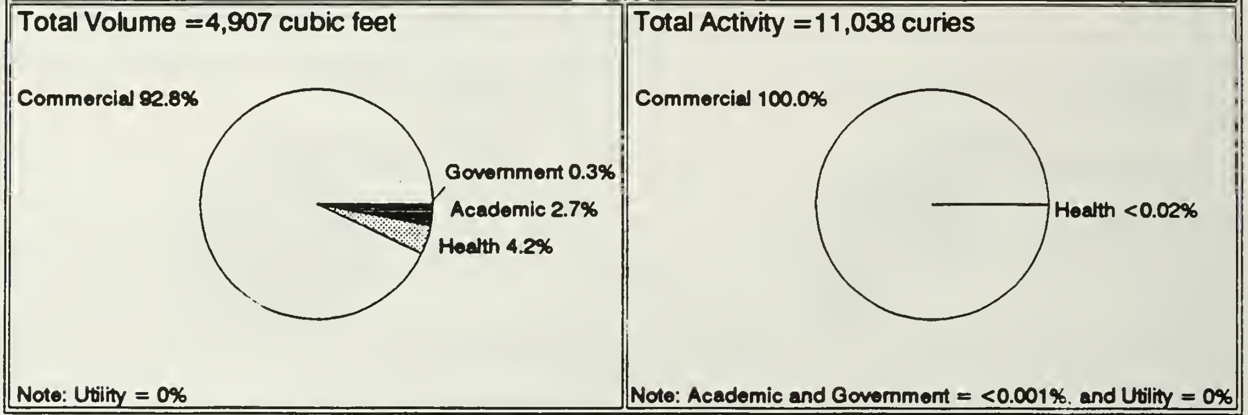
Total Activity =3,365 curies

Note: Government = <0.1%, and Utility = 0%

LLRW Storage for Future Disposal Summary

During 1993, 63 organizations reported that they had placed LLRW in storage for future disposal. LLRW generators store this waste for several reasons, including consolidation prior to shipment, storage to allow partial radioactive decay, a real or perceived lack of disposal capacity, or to await treatment prior to disposal. Figure 5 illustrates the quantity of LLRW placed in storage during 1993 by generator category. The total accumulation of LLRW in storage for future disposal is 12,043 cubic feet containing 17,489 curies, according to survey results.

Figure 5
1993 LLRW Volume and Activity Placed in Storage for Future Disposal – by Generator Category
(percent)



Total Volume =4,907 cubic feet

Total Activity =11,038 curies

Note: Utility = 0%

Note: Academic and Government = <0.001%, and Utility = 0%

LLRW Shipped for Disposal Summary

During 1993, 78 organizations reported that they shipped 106,980 cubic feet of LLRW for disposal, containing 38,070 curies of activity. This amount represents 11.3% of the radioactive waste volume produced. Tables 6 and 7 illustrate production and management of 1993 LLRW volume and activity shipped for disposal by each generator category. The number of organizations shipping LLRW for disposal decreased by 28 from 1992.

Table 6
1993 LLRW Volume Shipped for Disposal Management Summary – by Generator Category
(percent)

	Acad	Comm	Govt	Health	Utility	Total	% of Total
Produced	1,841.8	59,819.1	57,106.6	884.6	97,312.6	216,964.7	100.0
Eliminated by Off-Site Treatment	231.6	19,906.0	0.0	167.6	79,595.4	99,900.6	46.0
Eliminated by On-Site Treatment	1,233.1	7,463.6	0.0	367.5	1,020.0	10,084.3	4.6
Total Volume Reduction	1,464.7	27,369.6	0.0	535.1	80,615.4	109,984.8	50.7
Barnwell, South Carolina	377.0	6,013.5	3,312.1	349.6	16,697.2	26,749.3	12.3
Clive, Utah	0.0	25,577.0	53,794.5	0.0	0.0	79,371.5	36.6
Hanford, Washington	0.0	859.0	0.0	0.0	0.0	859.0	0.4
Total Shipped for Disposal	377.0	32,449.5	57,106.6	349.6	16,697.2	106,979.8	49.3

Table 7
1993 LLRW Activity Shipped for Disposal Management Summary – by Generator Category
(curies)

	Acad	Comm	Govt	Health	Utility	Total	% of Total
Produced	11.747	20,234.065	0.615	3.054	17,820.507	38,069.988	100.000
Barnwell, South Carolina	11.747	20,233.392	0.512	3.054	17,820.507	38,069.212	99.998
Clive, Utah	0.000	0.673	0.104	0.000	0.000	0.776	0.002
Hanford, Washington	0.000	<0.001	0.000	0.000	0.000	<0.001	0.000
Total Shipped for Disposal	11.747	20,234.065	0.615	3.054	17,820.507	38,069.988	100.000

Major 1993 LLRW Streams Shipped for Disposal

Table 8 provides a breakdown of major LLRW streams shipped for disposal during 1993. As in 1992, the 1993 Massachusetts LLRW stream was dominated by "decommissioning" waste. During the year, the U.S. Army continued decommissioning its Materials Technology Laboratory at the Watertown Arsenal and Texas Instruments, Inc. continued remediation of its site in Attleboro, which was previously authorized by the NRC for burial of radioactive materials. In addition, the Sprague Company disposed of soils, from the decommissioning of a former manufacturing site in North Adams, that were in storage for several years. Wastes from these short–term projects boosted the amount of LLRW volume Massachusetts shipped for disposal (estimated in 1992 to be 25,000 cubic feet annually) by approximately four and one–half times.

Table 8
Major 1993 LLRW Streams Shipped for Disposal
(cubic feet and curies)

Waste Description	Organization	Waste Type	Volume	% of Total	Activity	% of Total
Soils, Building Rubble	U.S. Army (Watertown)	Decommissioning	57,095.0	53.4	0.434	0.0
Soils, Building Rubble	Sprague	Decommissioning	15,849.0	14.8	0.050	0.0
Piping, Equipment	Yankee Atomic	Decommissioning	10,623.0	9.9	17,245.410	45.3
Soil	Texas Instruments	Decommissioning	8,288.0	7.7	0.059	0.0
Reactor Wastes	Boston Edison	Process	6,074.2	5.7	575.097	1.5
Absorbed Liquids	Du Pont Med. Prod.	Process	30.0	0.0	19,957.060	52.4
N/A	Remaining Waste	Process	9,020.6	8.4	291.878	0.8
Total			106,979.8	100.0	38,069.988	100.0

Note: See Table 1 for a complete description of waste categories.

The Army, Texas Instruments, and Sprague decommissioning projects produced large quantities of a type of LLRW known as high–volume, low–activity (HVLA). HVLA waste is typically comprised of soils or building rubble containing very small concentrations of radioactivity. For example, the Army, Texas Instruments, and Sprague shipped a combined total of 76,649 cubic feet of HVLA LLRW containing only 0.213 curies of activity to the Envirocare disposal facility in Clive, Utah, and the Army shipped 3,301 cubic feet of LLRW containing 0.33 curies to the disposal facility in Barnwell, South

Carolina. Together, Army, Texas Instruments, and Sprague wastes accounted for 75.9% of the total 1993 LLRW volume shipped for disposal.

During 1993, the Yankee Atomic Electric Co. began dismantling its power reactor in Rowe. LLRW shipped for disposal from this project consisted primarily of major components of the reactor and its primary coolant system, including the steam generators and irradiated hardware. These components were the principle contributors to the 10,623 cubic feet and 17,245 curies shipped for disposal by Yankee Atomic during 1993.

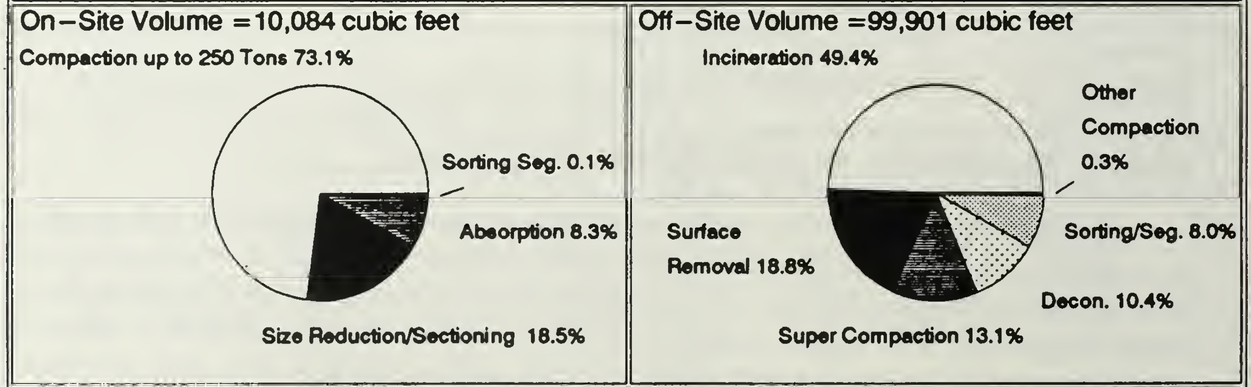
While the largest contribution to Massachusetts' 1993 LLRW shipped for disposal was from decommissioning sites, the impact from these projects will be short term, since they are scheduled to end during 1994. The Yankee Atomic component removal project will also proceed through mid–1994, but waste generation will resume near the year 2002 following a period of safe storage for decay. At this time, Yankee estimates that approximately 100,000 cubic feet of LLRW containing 5,180 curies, will require disposal in a licensed LLRW disposal facility. During 1993, the quantity of LLRW from "routine" sources (exclusive of decommissioning projects) fell to approximately 15,000 cubic feet.

LLRW Shipped for Disposal Treatment Summary

As illustrated by Table 6, LLRW requiring disposal undergoes significant volume reduction both on and off site, with the largest volume reduction (46.0%) occurring off site. There are a wide range of treatment processes available to the LLRW producer. However, as noted, treatment used on LLRW shipped for disposal during 1993 was for volume reduction.

Certain wastes must be processed to modify their physical form, to make them suitable for disposal. For example, liquids are often solidified with concrete. Other wastes do not require treatment prior to disposal, but are frequently shipped to out–of–state facilities for volume reduction processing because of the cost effectiveness that results for disposal. Figure 6 shows the amount of waste "volume eliminated," both on and off–site, by treatment method.

Figure 6
1993 LLRW Volume Eliminated by Treatment – by Treatment Method
(percent)



Note: Seg. = Segregation; Decon. = Decontamination.

Compaction is the most common treatment technique, both on and off site. Since on-site compactors tend to be smaller units, unable to achieve maximum compaction, generators often ship their LLRW to out-of-state processors who possess equipment that can achieve compaction forces of up to several thousand tons (super compaction).

As noted, many licensees take advantage of commercial treatment services, offered by out-of-state companies, since the price of disposal is based on the volume of waste delivered to the disposal facility. Typically, waste is picked up at the point of generation by brokers (companies in the business of arranging for treatment and\or disposal of radioactive materials and wastes). Frequently a broker will make multiple pickups, both in and out of state, before reaching an LLRW treatment facility. Processors are companies that operate radioactive waste treatment facilities; in some cases, brokers are also processors.

LLRW Disposal Site and Classification Summary

Tables 9 and 10 list production and management data for 1993 LLRW shipped for disposal by disposal class. During 1993, there were two disposal sites available to Massachusetts LLRW generators (Clive, Utah, and Barnwell, South Carolina), although one organization reported shipping waste to the Hanford site, in Washington, which officially closed to out-of-region waste on January 1, 1993.

As shown by Table 9, the largest amount of volume, 79,372 cubic feet, was shipped to the Envirocare facility and was classified as Class A and Class AH (see Section 2). The Envirocare facility is the only site licensed to accept mixed waste for disposal.

Table 10 illustrates the distribution of activity shipped to each disposal site by disposal class. The majority of activity in the 1993 LLRW was shipped to the Barnwell facility. The major contributors were 30 cubic feet of Class B waste containing 19,957 curies of H-3 (12.3 year half-life) from Du Pont Medical Products Co., and components from the disassembly of the Yankee Rowe power plant containing 15,955 curies of various radionuclides.

Table 9

1993 LLRW Volume Shipped for Disposal Summary – by Disposal Class

(cubic feet)

	Class A	Class AH [1]	Class B	Class C	Total	% of Total
Produced	162,346.9	53,794.5	822.3	1.0	216,964.7	100.0
Eliminated by Off-Site Treatment	99,900.6	0.0	0.0	0.0	99,900.6	46.0
Eliminated by On-Site Treatment	10,084.3	0.0	0.0	0.0	10,084.3	4.6
Total Volume Reduction	109,984.8	0.0	0.0	0.0	109,984.8	50.7
Barnwell, South Carolina	25,926.1	0.0	822.3	1.0	26,749.3	12.3
Clive, Utah	25,577.0	53,794.5	0.0	0.0	79,371.5	36.6
Hanford, Washington	859.0	0.0	0.0	0.0	859.0	0.4
Total Shipped for Disposal	52,362.1	53,794.5	822.3	1.0	106,979.8	49.3

[1] Class AH refers to mixed LLRW. See Section 2: Radioactive Waste Management Methods.

Table 10
1993 LLRW Activity Shipped for Disposal Summary – by Disposal Class
(curies)

	Class A	Class AH [1]	Class B	Class C	Total	% of Total
Produced	1,666.272	0.104	36,403.613	<0.001	38,069.988	100.0
Barnwell, South Carolina	1,665.599	0.000	36,403.613	<0.001	38,069.212	100.0
Clive, Utah	0.673	0.104	0.000	0.0000	0.776	0.0
Hanford, Washington	<0.001	0.000	0.000	0.000	<0.001	0.0
Total Shipped for Disposal	1,666.272	0.104	36,403.613	<0.001	38,069.988	100.0

[1] Class AH refers to mixed LLRW. See Section 2: Radioactive Waste Management Methods.

Figure 7 illustrates the breakdown of LLRW volume and activity shipped for disposal by disposal class. The largest contributor to 1993 LLRW volume shipped for disposal is Class A waste (99.2%), followed by Class B (0.8%), and Class C (<0.1%); by activity the largest contributor is Class B (95.6%), followed by Class A (4.4%), and Class C (<0.1%).

Figure 7
1993 LLRW Volume and Activity Shipped for Disposal – by Disposal Class
(percent)

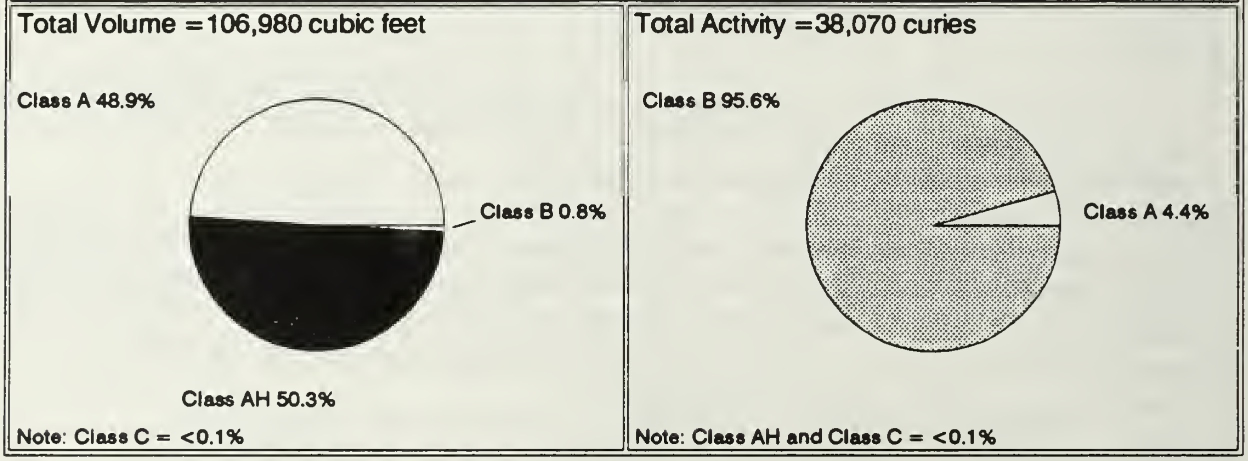


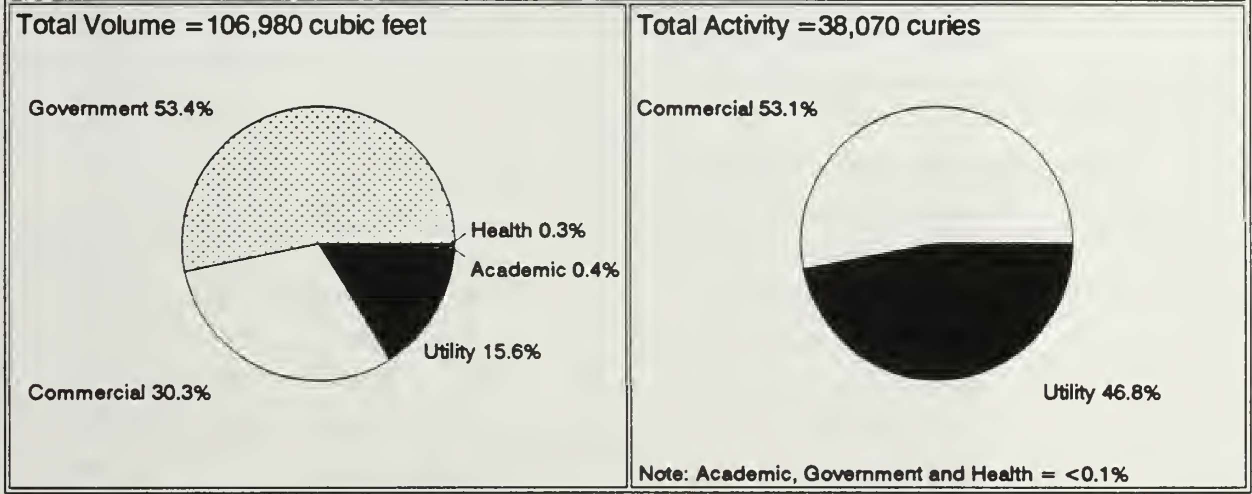
Figure 7 shows Class A divided into non–mixed LLRW and mixed waste (AH), totalling 99.2% of waste volume shipped for disposal in 1993. Radionuclide and concentration limits defining Class A LLRW are such that during a 100–year institutional control period, when a facility is actively maintained after closure, activity within the waste will decay to levels that could yield an acceptable dose (within regulatory limits) to a person who might inadvertently occupy a disposal site and encounter waste.

Less than 1% of LLRW volume shipped for disposal in 1993 was Class B and C. Because these wastes, typically produced in Massachusetts by nuclear power plants and a few commercial generators, contain larger concentrations of long–lived radionuclides, they must be placed in containers that will maintain their integrity for at least 300 years after disposal. In addition, Class C waste must be surrounded by additional barriers that will protect against inadvertent intrusion for at least 500 years.

Figure 7 also illustrates the relationship between disposal class and activity of 1993 LLRW shipped for disposal. Class A waste, while being the largest class by volume (99.2%), contains a small amount of activity (4.4%). Class B waste, while being a small amount by volume (0.8%) contains the greatest amount of activity (95.6%). As noted, the greatest contributor to Class B activity, 19,957 curies, is from Du Pont Medical Products Co., a commercial licensee that typically ships large amounts of H-3 waste as a result of manufacturing radiolabelled compounds used in life-sciences research.

Figure 8 provides a breakdown of volume and activity shipped for disposal by generator category. The largest contributor to 1993 LLRW volume shipped for disposal is the government category (53.4%), followed by commercial (30.3%), utility (15.6%), academic (0.4%), and health (0.3%). By activity, the largest contributor is the commercial category (53.1%), followed by utility (46.8%). For 1993, academic, government, and health categories totalled less than 0.1%. The percentage distribution shows how LLRW is retained during the manufacturing stage, which relieves the end user from the need to dispose of large quantities of waste.

Figure 8
1993 LLRW Volume and Activity Shipped for Disposal – by Generator Category
(percent)


Total Volume =106,980 cubic feet

Total Activity =38,070 curies

Note: Academic, Government and Health = <0.1%

Although Massachusetts ranks among the top 15 states shipping LLRW for disposal in the country, the Commonwealth's waste stream is unique in that the commercial sector usually ships more volume (and typically activity) for disposal than other generator categories. There are two main reasons for this phenomenon. First, Massachusetts, with one operating nuclear power plant, has a smaller nuclear LLRW component than other large LLRW producing states. Among the top 15 states, Massachusetts is tied with Oregon, which also has one nuclear power plant. The second reason is that Massachusetts is home to the Du Pont companies (within the commercial category), who are the largest manufacturers of radioactive compounds and radiopharmaceuticals in the country.

LLRW Shipped for Disposal Waste Category Summary

The annual LLRW survey form lists 32 different waste category choices. Table 11 provides a breakdown of 1993 LLRW shipped for disposal by waste category. Note that the table contains only the waste categories shipped for disposal. As indicated by the table, the majority of LLRW volume shipped for disposal falls within the dry active waste (DAW) category, while the largest amounts of activity resulted from the disposal of solidified liquids and irradiated reactor components.

DAW–Bulk Materials includes paper, plastic, glass, cloth, and soil; DAW–Solids comprises wood, metal, concrete, and equipment. Solidified liquids refers to liquids solidified with concrete, while irradiated reactor components represents equipment that has become radioactive, or activated, from exposure to neutrons in a nuclear reactor.

Table 11
1993 LLRW Volume and Activity Shipped for Disposal – by Waste Category

Waste Category[1]	Volume (cubic ft.)	% of Total	Activity (curies)	% of Total
DAW–Uncompacted Solids	54,066.8	50.5	114.226	0.3
DAW–Uncompacted Bulk Materials	28,654.2	26.8	6.652	0.0
Contaminated Large Metal Objects	7,068.0	6.6	1,285.700	3.4
DAW–Compacted Solids	4,541.9	4.2	5.370	0.0
DAW–Compacted Bulk Materials	4,533.8	4.2	141.309	0.4
Dewatered Ion Exchange Media	2,557.6	2.4	532.627	1.4
Incinerator Ash	1,773.6	1.7	8.605	0.0
Other Dewatered Sludges	1,452.3	1.4	0.563	0.0
Dewatered Filter Media	1,029.0	1.0	40.760	0.1
Irradiated Reactor Components	521.0	0.5	15,933.735	41.9
Absorbed Liquids	406.3	0.4	19,957.255	52.4
Solidified Liquids	122.7	0.1	11.293	0.0
Cartridge Filters	130.0	0.1	21.693	0.1
Sealed Sources	63.0	0.1	10.193	0.0
Biological Waste or Carcasses	59.7	0.1	0.007	0.0
Total	106,979.8	100.0	38,069.988	100.0

[1] As received at disposal site. See Table 1 for a description of waste categories.

Table 12 lists radionuclides contributing more than 1% of radioactivity in 1993 LLRW shipped for disposal and the generator category contributing the greatest amount of that nuclide. A complete list of radionuclides can be found in Appendix B.

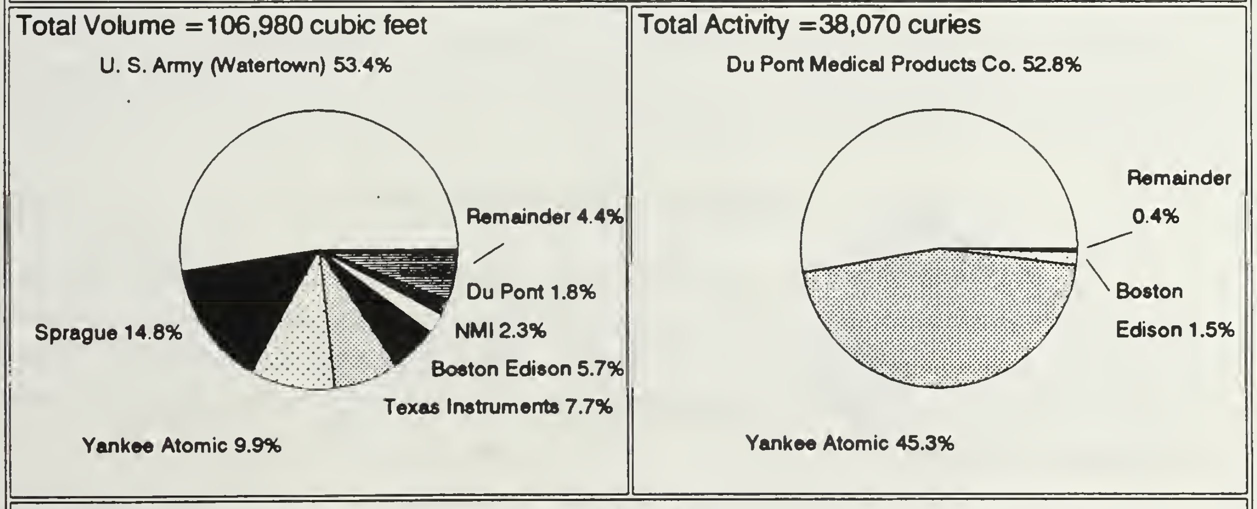
Table 12
Radionuclides Contributing More Than One Percent to 1993 Activity Shipped for Disposal
(curies)

Radionuclide	Half-life	Activity	% of Total	Major Contributor
Hydrogen-3 (Tritium)	12.3 years	20,174.065	53.0	Commercial
Silver-110m	250 days	5,960.003	15.7	Utility
Iron-55	996 days	5,703.521	15.0	Utility
Cobalt-60	5.27 Years	3,815.937	10.0	Utility
Cadmium-109	462 days	956.118	2.5	Utility
Nickel-63	100 years	691.549	1.8	Utility
Remaining Nuclides	N/A	768.795	2.0	N/A
Total	N/A	38,069.988	100.0	

Chief 1993 LLRW Shippers

Major generators of LLRW volume and activity are presented in Figure 9. Additional information on waste volumes, reasons for the use of radioactive materials, treatment results, and shipping information for each organization that reported producing waste in the Commonwealth during 1993 can be found in Appendix A.

Figure 9
1993 LLRW Volume and Activity Shipped for Disposal – by Chief Shippers
(percent)



Note: Du Pont = Du Pont Medical Products Co.; NMI = Nuclear Metals, Inc.

5. Summary of 1993 Other Radioactive Waste Data

Figures in this section summarize each management method within the other radioactive waste category described earlier in this report. Data are presented on atmospheric releases, sewerage releases, and transfers to authorized recipients. Detailed data on these procedures can be found in Section 9.

Information in this section and Section 9 is included in this report for informational purposes, as the waste of interest is not legally part of the LLRW category. Data in this section is supplied by generators on a voluntary basis. As such, some generators provide the information, and some do not. Therefore, caution should be used when interpreting this data, since it may not be complete and may not represent the total quantities of other radioactive waste managed by each technique.

Atmospheric Release Summary

During 1993, four organizations reported the release to the atmosphere of 9,029 cubic feet of gaseous radioactive effluents, containing 33.6 curies of activity. It is routine practice for some licensees to discharge small quantities of radioactive materials to the atmosphere in accordance with NRC regulations. If these radioactive gases were packaged for disposal, they would be considered LLRW.

Survey responses indicate that atmospheric release sources can be divided into two types—incidental and process. Examples of incidental releases include exhaust vents from cleanrooms (e.g., areas where radiopharmaceuticals are manufactured) or laboratory hoods, while process sources include releases from systems which are periodically vented. All releases must meet NRC concentration criteria and be documented for inspection purposes.

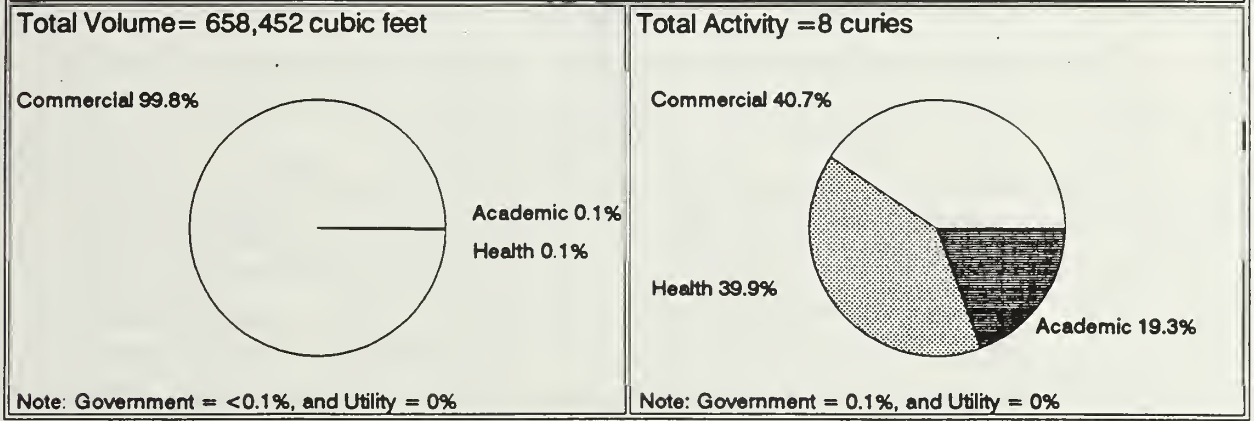
During 1993, 99.7% of the reported activity in the materials released was Krypton–85 (10.5 year half–life), a chemically inert gas, from process systems operated by AT&T Network Systems and Raytheon Company.

Sewerage Release Summary

During 1993, 77 organizations reported that they released incidental radionuclides into sanitary sewerage systems as allowed by NRC regulations. These aqueous liquid wastes must meet the radionuclide effluent concentration limits specified by Table 3 of Appendix B to 10 CFR 20. Figure 10 illustrates the quantity of radioactive effluents discharged to sanitary sewerage systems reported by various generator categories.

The largest contributor to this category during 1993 was Interstate Nuclear Services, operator of a nuclear laundry, that discharged 652,418 cubic feet of washing machine effluents containing 0.178 curies of activity.

Figure 10
1993 Volume and Activity Released to Sanitary Sewers – by Generator Category
(percent)



Total Volume= 658,452 cubic feet

Note: Government = <0.1%, and Utility = 0%

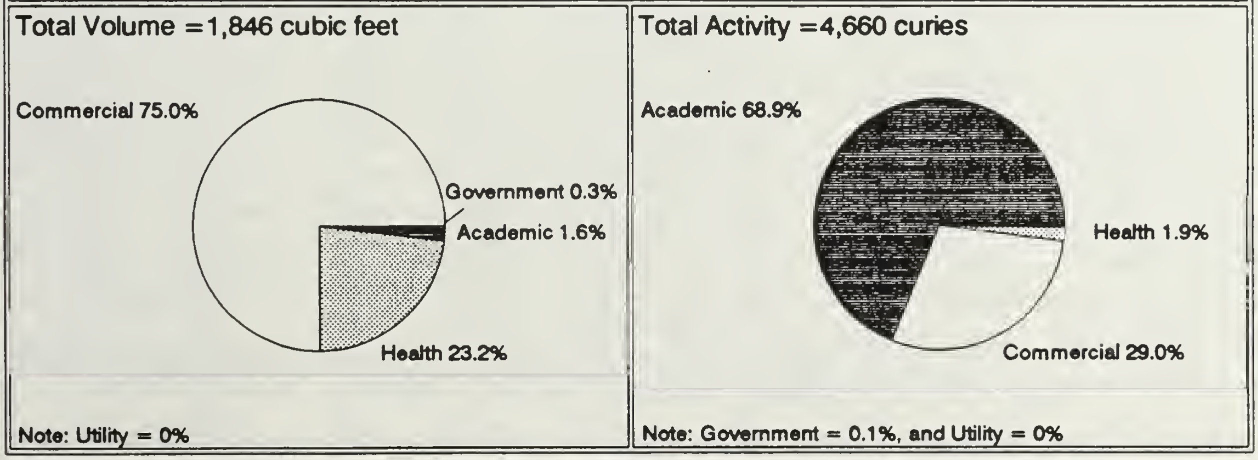
Total Activity =8 curies

Note: Government = 0.1%, and Utility = 0%

Transfer to Authorized Recipients Summary

During 1993, 46 organizations transferred radioactive waste for disposal and reusable materials for recycling to authorized recipients (usually the original supplier). Typical waste categories returned include sealed sources used within devices and for instrument calibration, and radiopharmaceutical dispensing units known as medical isotope generators. Figure 11 summarizes the volume and activity of radioactive wastes and reusable materials transferred to authorized recipients during 1993, by generator category.

Figure 11
1993 Volume and Activity Transferred to Authorized Recipients – by Generator Category
(percent)



Total Volume =1,846 cubic feet

Note: Utility = 0%

Total Activity =4,660 curies

Note: Government = 0.1%, and Utility = 0%

6. 1993 Radioactive Waste Characteristic Data

Tables in this section present waste category information for all radioactive wastes, including LLRW shipped for disposal and other liquid and gaseous wastes, managed by the various methods described in this report.

Table 13
1993 Radioactive Waste Volume Produced – by Waste and Generator Category
(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	2,127.3	12,748.5	0.0	67.5	1,275.0	16,218.3	1.7
DAW–Bulk Materials	7,121.8	49,693.0	3,354.1	12,805.4	64,050.0	137,024.3	14.5
DAW–Compacted Solids	0.0	859.0	0.0	0.0	0.0	859.0	0.1
DAW–Solids	22.8	18,358.6	53,794.5	0.0	18,465.0	90,640.9	9.6
DAW–Medical Wastes	300.0	759.6	0.0	8,644.1	0.0	9,703.7	1.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	9,030.0	9,030.0	1.0
Dewatered Ion Exchange Media	0.0	2.2	0.0	0.0	2,557.6	2,559.8	0.3
Dewatered Filter Media	0.0	22.5	0.0	0.0	1,029.0	1,051.5	0.1
Other Dewatered Sludges	12.3	1,470.0	0.0	0.0	0.0	1,482.3	0.2
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	130.0	130.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	200.0	1,394.7	0.0	63.0	0.0	1,657.7	0.2
Solidified Liquids	4.0	444.2	0.0	0.0	0.0	448.2	0.0
LSF\Vials Organic	529.8	1,197.9	0.0	1,010.5	0.0	2,738.2	0.3
LSF\Vials Inorganic	594.9	908.5	3.1	254.5	0.0	1,760.9	0.2
Other Organic Liquids	10.3	61.1	0.0	0.0	0.0	71.4	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	478.0	285.8	4.1	168.5	0.0	936.4	0.1
Irradiated Reactor Components	0.0	0.0	0.0	0.0	521.0	521.0	0.1
Other Irradiated Materials	7.5	3.0	0.0	0.0	0.0	10.5	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	37.4	275.4	6.5	16.1	0.0	335.4	0.0
Contaminated Oil\Lubricant	0.0	67.5	0.0	0.0	255.0	322.5	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	16.0	0.0	2.7	1,181.1	0.0	1,199.8	0.1
Aqueous Liquids	977.1	657,892.4	0.1	447.0	0.0	659,316.6	69.6
Off–Gas	0.0	9,024.6	0.0	0.0	0.0	9,024.6	1.0
Total	12,439.2	755,468.5	57,165.1	24,657.7	97,312.6	947,043.1	100.0
% of Total	1.3	79.8	6.0	2.6	10.3	100.0	

Table 14

1993 Radioactive Waste Activity Produced – by Waste and Generator Category

(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	8.6203	275.4295	0.0000	0.0080	0.0542	284.1120	0.5
DAW–Bulk Materials	13.8186	257.7009	0.3721	445.7342	1.6022	719.2281	1.3
DAW–Compacted Solids	0.0000	0.0003	0.0000	0.0000	0.0000	0.0003	0.0
DAW–Solids	0.0000	587.4591	0.1035	0.0000	0.4815	588.0442	1.0
DAW–Medical Wastes	0.0000	4.9861	0.0000	2,046.6490	0.0000	2,051.6351	3.6
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	1,289.5489	1,289.5489	2.3
Dewatered Ion Exchange Media	0.0000	0.0500	0.0000	0.0000	532.6267	532.6767	0.9
Dewatered Filter Media	0.0000	0.1500	0.0000	0.0000	40.7605	40.9105	0.1
Other Dewatered Sludges	0.0001	0.7630	0.0000	0.0000	0.0000	0.7631	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0020	0.0000	0.0000	21.6930	21.6950	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.5000	0.8646	0.0000	0.1263	0.0000	1.4909	0.0
Solidified Liquids	0.0009	0.5430	0.0000	0.0000	0.0000	0.5439	0.0
LSF\Vials Organic	1.4370	35.4110	0.0000	1.3350	0.0000	38.1829	0.1
LSF\Vials Inorganic	0.6301	266.9352	0.0003	0.0870	0.0000	267.6526	0.5
Other Organic Liquids	0.0200	307.6013	0.0000	0.0000	0.0000	307.6213	0.5
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	2.6399	0.0768	0.0000	0.9839	0.0000	3.7006	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	15,933.7350	15,933.7350	27.9
Other Irradiated Materials	0.3043	0.0584	0.0000	0.0000	0.0000	0.3626	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	3,211.1008	11,438.4820	0.3905	11.0142	0.0000	14,660.9875	25.6
Contaminated Oil\Lubricant	0.0000	0.0002	0.0000	0.0000	0.0052	0.0054	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	10.0400	0.0000	6.0000	366.6814	0.0000	382.7214	0.7
Aqueous Liquids	4.6157	20,006.0417	0.0109	9.2223	0.0000	20,019.8906	35.0
Off–Gas	0.0000	33.6300	0.0000	0.0000	0.0000	33.6300	0.1
Total	3,253.7277	33,216.1852	6.8774	2,881.8412	17,820.5073	57,179.1387	100.0
% of Total	5.7	58.1	0.0	5.0	31.2	100.0	

7. 1993 LLRW Characteristic Data

Tables within this section provide detailed waste category data for each management method used for LLRW. Data is presented on LLRW incinerated for disposal, stored for decay, placed in storage, and shipped for disposal. In addition, data on treatment methods and results, disposal class, half-life, and radiation levels is supplied for LLRW shipped for disposal.

LLRW Incineration for Disposal

Table 15

1993 Volume Incinerated for Disposal Off-Site – by Waste and Generator Category

(cubic feet)

	Generator Category						
Waste Category	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW-Compacted Bulk Material	82.5	0.0	0.0	0.0	0.0	82.5	1.7
DAW-Bulk Materials	0.0	0.0	0.0	1,274.7	0.0	1,274.7	26.2
DAW-Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW-Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW-Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.7	0.0	0.0	0.0	0.7	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	504.2	738.3	0.0	970.5	0.0	2,213.1	45.5
LSF\Vials Inorganic	516.9	330.3	0.0	141.5	0.0	988.7	20.3
Other Organic Liquids	0.0	8.1	0.0	0.0	0.0	8.1	0.2
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash-Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash-Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	89.7	0.0	142.2	0.0	231.9	4.8
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	67.5	0.0	0.0	0.0	67.5	1.4
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1,103.6	1,234.7	0.0	2,528.9	0.0	4,867.2	100.0
% of Total	22.7	25.4	0.0	52.0	0.0	100.0	

Table 16
1993 Activity Incinerated for Disposal Off-Site – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW-Compacted Bulk Material	0.0390	0.0000	0.0000	0.0000	0.0000	0.0390	0.8
DAW-Bulk Materials	0.0000	0.0000	0.0000	0.6215	0.0000	0.6215	12.2
DAW-Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW-Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW-Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0010	0.0000	0.0000	0.0000	0.0010	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	1.4259	0.0619	0.0000	1.3340	0.0000	2.8218	55.3
LSF\Vials Inorganic	0.5987	0.0205	0.0000	0.0011	0.0000	0.6203	12.2
Other Organic Liquids	0.0000	0.0211	0.0000	0.0000	0.0000	0.0211	0.4
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash-Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash-Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0026	0.0000	0.9775	0.0000	0.9800	19.2
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases In Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0002	0.0000	0.0000	0.0000	0.0002	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	2.0636	0.1073	0.0000	2.9340	0.0000	5.1049	100.0
% of Total	40.4	2.1	0.0	57.5	0.0	100.0	

Table 17
1993 Volume Incinerated for Disposal On-Site – by Waste and Generator Category
(cubic feet)

	Generator Category						
Waste Category	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW-Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW-Bulk Materials	8.9	0.0	0.0	42.6	0.0	51.5	90.2
DAW-Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW-Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW-Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	3.0	0.0	3.0	5.2
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash-Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash-Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	2.3	0.4	0.0	0.0	0.0	2.6	4.6
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	11.2	0.4	0.0	45.6	0.0	57.2	100.0
% of Total	19.6	0.6	0.0	79.8	0.0	100.0	

Table 18

1993 Activity Incinerated for Disposal On–Site – by Waste and Generator Category

(curies)

Waste Category	Generator Category						
	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Bulk Materials	0.1438	0.0000	0.0000	0.0383	0.0000	0.1821	84.2
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0020	0.0000	0.0020	0.9
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0277	0.0045	0.0000	0.0000	0.0000	0.0322	14.9
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases In Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.1716	0.0045	0.0000	0.0403	0.0000	0.2163	100.0
% of Total	79.3	2.1	0.0	18.6	0.0	100.0	

Table 19
1993 Storage for Decay Volume – by Waste and Generator Category
(cubic feet)

Waste Category	Generator Category						
	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	1,234.8	1,375.8	0.0	0.0	0.0	2,610.6	6.0
DAW–Bulk Materials	5,321.8	12,311.3	34.8	10,592.6	0.0	28,260.4	64.6
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	169.8	0.0	0.0	0.0	169.8	0.4
DAW–Medical Wastes	300.0	684.5	0.0	8,596.5	0.0	9,581.0	21.9
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	2.2	0.0	0.0	0.0	2.2	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	240.4	0.0	0.0	0.0	240.4	0.5
Solidified Liquids	0.0	406.0	0.0	0.0	0.0	406.0	0.9
LSF\Vials Organic	15.1	75.2	0.0	40.0	0.0	130.3	0.3
LSF\Vials Inorganic	76.0	210.6	0.0	100.0	0.0	386.6	0.9
Other Organic Liquids	10.0	45.5	0.0	0.0	0.0	55.5	0.1
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	250.0	75.0	4.1	0.0	0.0	329.1	0.8
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	1.0	0.0	0.0	0.0	1.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	16.0	0.0	0.0	788.1	0.0	804.1	1.8
Aqueous Liquids	273.3	502.1	0.0	10.0	0.0	785.4	1.8
Total	7,496.9	16,099.4	38.9	20,127.2	0.0	43,762.4	100.0
% of Total	17.1	36.8	0.1	46.0	0.0	100.0	

Note: On and off–site total combined.

Table 20
1993 Storage for Decay Activity – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	1.4023	0.3995	0.0000	0.0000	0.0000	1.8018	0.1
DAW–Bulk Materials	8.7831	96.4699	0.0408	442.0190	0.0000	547.3127	16.3
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	38.0255	0.0000	0.0000	0.0000	38.0255	1.1
DAW–Medical Wastes	0.0000	4.8810	0.0000	2,044.6770	0.0000	2,049.5580	60.9
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0500	0.0000	0.0000	0.0000	0.0500	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.7814	0.0000	0.0000	0.0000	0.7814	0.0
Solidified Liquids	0.0000	0.4230	0.0000	0.0000	0.0000	0.4230	0.0
LSF\Vials Organic	0.0091	34.9226	0.0000	0.0010	0.0000	34.9327	1.0
LSF\Vials Inorganic	0.0301	38.3200	0.0000	0.0809	0.0000	38.4310	1.1
Other Organic Liquids	0.0200	298.1612	0.0000	0.0000	0.0000	298.1812	8.9
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	2.6000	0.0440	0.0000	0.0000	0.0000	2.6440	0.1
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	10.0400	0.0000	0.0000	287.8802	0.0000	297.9202	8.9
Aqueous Liquids	3.5765	44.9437	0.0000	6.0250	0.0000	54.5452	1.6
Total	26.4611	557.4218	0.0408	2,780.6831	0.0000	3,364.6068	100.0
% of Total	0.8	16.6	0.0	82.6	0.0	100.0	

Note: On and off–site total combined.

LLRW Placed in Storage

Storage data represents waste placed in storage during 1993 for future off–site disposal. Data in this section does not include waste stored for complete decay.

Table 21
1993 LLRW Volume Placed in Storage – by Waste and Generator Category
(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0	1,210.5	0.0	0.0	0.0	1,210.5	24.7
DAW–Bulk Materials	93.3	678.2	11.4	142.5	0.0	925.3	18.9
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	22.8	1,549.2	0.0	0.0	0.0	1,572.0	32.0
DAW–Medical Wastes	0.0	75.0	0.0	28.6	0.0	103.6	2.1
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	22.5	0.0	0.0	0.0	22.5	0.5
Other Dewatered Sludges	0.0	7.5	0.0	0.0	0.0	7.5	0.2
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	10.5	384.4	0.0	0.0	0.0	394.9	8.0
LSF\Vials Inorganic	0.0	322.6	1.0	0.0	0.0	323.6	6.6
Other Organic Liquids	0.0	7.5	0.0	0.0	0.0	7.5	0.2
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	11.4	0.0	26.3	0.0	37.7	0.8
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	7.5	2.0	0.0	0.0	0.0	9.5	0.2
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	58.2	0.0	0.0	0.0	58.2	1.2
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	226.5	0.0	7.5	0.0	234.0	4.8
Total	134.1	4,555.4	12.4	204.9	0.0	4,906.7	100.0
% of Total	2.7	92.8	0.3	4.2	0.0	100.0	

Table 22
1993 LLRW Activity Placed in Storage – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0000	144.2649	0.0000	0.0000	0.0000	144.2649	1.3
DAW–Bulk Materials	0.3342	153.6047	0.0000	1.2610	0.0000	155.1999	1.4
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	430.9440	0.0000	0.0000	0.0000	430.9440	3.9
DAW–Medical Wastes	0.0000	0.1041	0.0000	0.0020	0.0000	0.1061	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.1500	0.0000	0.0000	0.0000	0.1500	0.0
Other Dewatered Sludges	0.0000	0.2000	0.0000	0.0000	0.0000	0.2000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0020	0.0000	0.0000	0.0000	0.0020	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.0019	0.4265	0.0000	0.0000	0.0000	0.4284	0.0
LSF\Vials Inorganic	0.0000	217.4480	0.0001	0.0000	0.0000	217.4482	2.0
Other Organic Liquids	0.0000	9.4190	0.0000	0.0000	0.0000	9.4190	0.1
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0184	0.0000	0.0064	0.0000	0.0249	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.3043	0.0583	0.0000	0.0000	0.0000	0.3626	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	10,078.2449	0.0000	0.0000	0.0000	10,078.2449	91.3
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.7893	0.0000	0.0120	0.0000	0.8013	0.0
Total	0.6403	11,035.6742	0.0002	1.2815	0.0000	11,037.5962	100.0
% of Total	0.0	100.0	0.0	0.0	0.0	100.0	

Table 23
Total Accumulated LLRW Volume in Storage – by Waste and Generator Category
(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0	2,579.9	0.0	0.0	0.0	2,579.9	21.4
DAW–Bulk Materials	179.3	721.0	41.8	142.5	0.0	1,084.5	9.0
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	22.8	1,568.5	0.0	0.0	0.0	1,591.3	13.2
DAW–Medical Wastes	0.0	95.1	0.0	116.8	0.0	211.9	1.8
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	22.5	0.0	0.0	0.0	22.5	0.2
Other Dewatered Sludges	0.0	7.5	0.0	0.0	0.0	7.5	0.1
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.5	0.0	0.0	0.0	0.5	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	1.1	0.0	0.0	0.0	1.1	0.0
Solidified Liquids	0.0	480.0	0.0	0.0	0.0	480.0	4.0
LSF\Vials Organic	12.5	924.4	0.0	0.0	0.0	936.9	7.8
LSF\Vials Inorganic	0.0	322.6	1.0	0.0	0.0	323.6	2.7
Other Organic Liquids	0.0	3,960.0	0.0	0.0	0.0	3,960.0	32.9
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	11.4	0.0	26.3	0.0	37.7	0.3
Irradiated Reactor Components	0.0	0.0	0.0	0.0	295.7	295.7	2.5
Other Irradiated Materials	7.5	3.0	0.0	0.0	0.0	10.5	0.1
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	105.2	0.5	0.0	0.0	105.7	0.9
Contaminated Oil\Lubricant	0.0	7.5	0.0	0.0	0.0	7.5	0.1
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	228.5	0.0	7.5	0.0	236.0	2.0
Other	0.0	0.0	0.0	0.0	150.0	150.0	1.2
Total	222.1	11,038.7	43.3	293.1	445.7	12,042.8	100.0
% of Total	1.8	91.7	0.4	2.4	3.7	100.0	

Table 24
Total Accumulated LLRW Activity in Storage – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0000	144.2753	0.0000	0.0000	0.0000	144.2753	0.8
DAW–Bulk Materials	0.4326	153.6726	0.0045	1.2610	0.0000	155.3707	0.9
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	430.9761	0.0000	0.0000	0.0000	430.9761	2.5
DAW–Medical Wastes	0.0000	0.1096	0.0000	0.0068	0.0000	0.1164	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.1500	0.0000	0.0000	0.0000	0.1500	0.0
Other Dewatered Sludges	0.0000	0.2000	0.0000	0.0000	0.0000	0.2000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0040	0.0000	0.0000	0.0000	0.0040	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0120	0.0000	0.0000	0.0000	0.0120	0.0
Solidified Liquids	0.0000	0.0099	0.0000	0.0000	0.0000	0.0099	0.0
LSF\Vials Organic	0.0023	646.7311	0.0000	0.0000	0.0000	646.7334	3.7
LSF\Vials Inorganic	0.0000	217.4480	0.0001	0.0000	0.0000	217.4482	1.2
Other Organic Liquids	0.0000	5,807.5242	0.0000	0.0000	0.0000	5,807.5242	33.2
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0184	0.0000	0.0064	0.0000	0.0249	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.3043	0.0875	0.0000	0.0000	0.0000	0.3918	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	10,082.7451	0.0720	0.0000	0.0000	10,082.8171	57.7
Contaminated Oil\Lubricant	0.0000	2.0273	0.0000	0.0000	0.0000	2.0273	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.7900	0.0000	0.0120	0.0000	0.8020	0.0
Other	0.0000	0.0000	0.0000	0.0000	0.0192	0.0192	0.0
Total	0.7391	17,486.7813	0.0766	1.2862	0.0192	17,488.9024	100.0
% of Total	0.0	100.0	0.0	0.0	0.0	100.0	

Table 25

1993 LLRW Volume as Generated[1] – by Waste and Generator Category

(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	810.0	6,459.6	0.0	67.5	1,275.0	8,612.1	4.0
DAW–Bulk Materials	977.2	34,245.4	3,308.0	753.0	64,050.0	103,333.6	47.6
DAW–Compacted Solids	0.0	859.0	0.0	0.0	0.0	859.0	0.4
DAW–Solids	0.0	15,413.3	53,794.5	0.0	18,465.0	87,672.8	40.4
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	9,030.0	9,030.0	4.2
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	2,557.6	2,557.6	1.2
Dewatered Filter Media	0.0	0.0	0.0	0.0	1,029.0	1,029.0	0.5
Other Dewatered Sludges	12.3	1,440.0	0.0	0.0	0.0	1,452.3	0.7
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	130.0	130.0	0.1
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	1,153.6	0.0	60.0	0.0	1,213.6	0.6
Solidified Liquids	4.0	38.2	0.0	0.0	0.0	42.2	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	45.0	0.0	0.0	0.0	45.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	74.7	0.0	0.0	0.0	74.7	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	521.0	521.0	0.2
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	8.3	60.3	4.1	3.4	0.0	76.1	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	255.0	255.0	0.1
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	30.0	30.0	0.0	0.7	0.0	60.7	0.0
Total	1,841.8	59,819.1	57,106.6	884.6	97,312.6	216,964.7	100.0
% of Total	0.8	27.6	26.3	0.4	44.9	100.0	

[1] Prior to treatment.

Table 26
On–Site Treatment Results for LLRW Shipped for Disposal – by Treatment Method
(cubic feet)

Treatment Description	Before	After	Total Reduction	% of Total	Reduction Ratio[1]
Compaction:up to 250 Tons of Force	11,237.3	3,868.0	7,369.2	73.1	2.9
Size Reduction/Sectioning	5,608.2	3,738.8	1,869.4	18.5	1.5
Absorption	1,110.0	277.5	832.5	8.3	4.0
Sorting/Segregation	45.9	32.8	13.1	0.1	1.4
Total	18,001.4	7,917.1	10,084.3	100.0	N/A

[1] (Initial volume/ final volume)

Table 27
On–Site Treatment Results for LLRW Shipped for Disposal – by Waste Category
(cubic feet)

Waste Category	Before	After	Total Reduction	% of Total	Reduction Ratio
DAW–Compacted Bulk Materials	8,574.6	2,986.0	5,588.6	55.4	2.9
DAW–Uncompacted Bulk Materials	8,270.9	4,620.8	3,650.0	36.2	1.8
Absorbed Liquids	1,110.0	277.5	832.5	8.3	4.0
Sealed Sources	45.9	32.8	13.1	0.1	1.4
Total	18,001.4	7,917.1	10,084.3	100.0	N/A

Table 28
Off–Site Treatment Results for LLRW Shipped for Disposal – by Treatment Method
(cubic feet)

Treatment Description	Before	After	Total Reduction	% of Total	Reduction Ratio
Incineration	51,121.6	1,743.6	49,378.0	49.4	29.3
Surface Removal	20,480.0	1,702.0	18,778.0	18.8	12.0
Compaction: Above 2,500 Tons of Force	16,520.7	3,477.8	13,042.9	13.1	4.8
Decontamination	11,520.0	1,153.6	10,366.4	10.4	10.0
Sorting/Segregation	8,907.0	867.0	8,040.0	8.0	10.3
Compaction: up to 250 Tons of Force	380.6	113.9	266.7	0.3	3.3
Compaction: 1,001–2,500 Tons of Force	51.9	23.3	28.6	0.0	2.2
Total	108,981.8	9,081.2	99,900.6	100.0	N/A

Table 29
Off–Site Treatment Results for LLRW Shipped for Disposal – by Waste Category
(cubic feet)

Waste Category	Before	After	Total Reduction	% of Total	Reduction Ratio
DAW–Uncompacted Bulk Materials	70,874.8	4,087.2	66,787.6	66.9	17.3
DAW–Uncompacted Solids	33,606.0	3,363.2	30,242.8	30.3	10.0
Contaminated Large Metal Objects	1,962.0	624.0	1,338.0	1.3	3.1
DAW–Compacted Bulk Materials	2,284.0	1,006.3	1,277.7	1.3	2.3
Contaminated Oil/Lubricant	255.0	0.5	254.5	0.3	510.0
Total	108,981.8	9,081.2	99,900.6	100.0	N/A

Table 30

1993 LLRW Volume Shipped for Disposal – by Waste and Generator Category

(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	271.9	2,165.5	0.0	139.4	1,957.0	4,533.8	4.2
DAW–Bulk Materials	50.5	25,069.6	3,308.0	146.1	80.0	28,654.2	26.8
DAW–Compacted Solids	0.0	2,521.3	0.0	0.0	2,020.6	4,541.9	4.2
DAW–Solids	0.0	272.3	53,794.5	0.0	0.0	54,066.8	50.5
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	7,068.0	7,068.0	6.6
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	2,557.6	2,557.6	2.4
Dewatered Filter Media	0.0	0.0	0.0	0.0	1,029.0	1,029.0	1.0
Other Dewatered Sludges	12.3	1,440.0	0.0	0.0	0.0	1,452.3	1.4
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	130.0	130.0	0.1
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	30.0	315.6	0.0	60.7	0.0	406.3	0.4
Solidified Liquids	4.0	118.7	0.0	0.0	0.0	122.7	0.1
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	439.6	0.0	0.0	1,334.0	1,773.6	1.7
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	59.7	0.0	0.0	0.0	59.7	0.1
Irradiated Reactor Components	0.0	0.0	0.0	0.0	521.0	521.0	0.5
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	8.3	47.2	4.1	3.4	0.0	63.0	0.1
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	377.0	32,449.5	57,106.6	349.6	16,697.2	106,979.8	100.0
% of Total	0.4	30.3	53.4	0.3	15.6	100.0	

Table 31
1993 LLRW Activity Shipped for Disposal – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	11.7283	129.0744	0.0000	0.1935	0.3124	141.3086	0.4
DAW–Bulk Materials	0.0083	4.7009	0.3313	1.6088	0.0031	6.6524	0.0
DAW–Compacted Solids	0.0000	1.0397	0.0000	0.0000	4.3305	5.3702	0.0
DAW–Solids	0.0000	114.1226	0.1035	0.0000	0.0000	114.2262	0.3
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	1,285.7000	1,285.7000	3.4
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	532.6267	532.6267	1.4
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	40.7605	40.7605	0.1
Other Dewatered Sludges	0.0001	0.5630	0.0000	0.0000	0.0000	0.5631	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	21.6930	21.6930	0.1
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0091	19,957.1167	0.0000	0.1293	0.0000	19,957.2551	52.4
Solidified Liquids	0.0009	11.2922	0.0000	0.0000	0.0000	11.2930	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	0.0000	7.2586	0.0000	0.0000	1.3462	8.6047	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0067	0.0000	0.0000	0.0000	0.0067	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	15,933.7350	15,933.7350	41.9
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0008	8.8899	0.1804	1.1222	0.0000	10.1934	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	11.7474	20,234.0646	0.6153	3.0538	17,820.5073	38,069.9885	100.0
% of Total	0.0	53.1	0.0	0.0	46.8	100.0	

Table 32
1993 LLRW Volume Shipped for Disposal – by Waste Category and Disposal Class
(cubic feet)

Waste Category	Disposal Classification					
	Class A	Class AH	Class B	Class C	Total	% of Total
DAW–Compacted Bulk Material	4,526.3	0.0	7.5	0.0	4,533.8	4.2
DAW–Bulk Materials	28,654.2	0.0	0.0	0.0	28,654.2	26.8
DAW–Compacted Solids	4,541.9	0.0	0.0	0.0	4,541.9	4.2
DAW–Solids	272.3	53,794.5	0.0	0.0	54,066.8	50.5
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	7,068.0	0.0	0.0	0.0	7,068.0	6.6
Dewatered Ion Exchange Media	2,425.2	0.0	132.4	0.0	2,557.6	2.4
Dewatered Filter Media	1,029.0	0.0	0.0	0.0	1,029.0	1.0
Other Dewatered Sludges	1,452.3	0.0	0.0	0.0	1,452.3	1.4
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	130.0	0.0	130.0	0.1
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	376.3	0.0	30.0	0.0	406.3	0.4
Solidified Liquids	122.7	0.0	0.0	0.0	122.7	0.1
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	1,773.6	0.0	0.0	0.0	1,773.6	1.7
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	59.7	0.0	0.0	0.0	59.7	0.1
Irradiated Reactor Components	0.0	0.0	521.0	0.0	521.0	0.5
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0
Gases In Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	60.6	0.0	1.4	1.0	63.0	0.1
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Total	52,362.1	53,794.5	822.3	1.0	106,979.8	100.0
% of Total	48.9	50.3	0.8	0.0	100.0	

Table 33

1993 LLRW Activity Shipped for Disposal – by Waste Category and Disposal Class

(curies)

	Disposal Classification					
Waste Category	Class A	Class AH	Class B	Class C	Total	% of Total
DAW–Compacted Bulk Material	140.1786	0.0000	1.1300	0.0000	141.3086	0.4
DAW–Bulk Materials	6.6524	0.0000	0.0000	0.0000	6.6524	0.0
DAW–Compacted Solids	5.3702	0.0000	0.0000	0.0000	5.3702	0.0
DAW–Solids	114.1226	0.1035	0.0000	0.0000	114.2262	0.3
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	1,285.7000	0.0000	0.0000	0.0000	1,285.7000	3.4
Dewatered Ion Exchange Media	50.3264	0.0000	482.3003	0.0000	532.6267	1.4
Dewatered Filter Media	40.7605	0.0000	0.0000	0.0000	40.7605	0.1
Other Dewatered Sludges	0.5631	0.0000	0.0000	0.0000	0.5631	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	21.6930	0.0000	21.6930	0.1
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.1951	0.0000	19,957.0600	0.0000	19,957.2551	52.4
Solidified Liquids	11.2930	0.0000	0.0000	0.0000	11.2930	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	8.6047	0.0000	0.0000	0.0000	8.6047	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0067	0.0000	0.0000	0.0000	0.0067	0.0
Irradiated Reactor Components	0.0000	0.0000	15,933.7350	0.0000	15,933.7350	41.9
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	2.4984	0.0000	7.6948	0.0001	10.1934	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	1,666.2716	0.1035	36,403.6132	0.0001	38,069.9885	100.0
% of Total	4.4	0.0	95.6	0.0	100.0	

Table 34
1993 LLRW Volume Shipped for Disposal – by Generator Category and Disposal Class
(cubic feet)

	Disposal Classification					
Generator Category	Class A	Class AH	Class B	Class C	Total	% of Total
Academic	368.5	0.0	7.5	1.0	377.0	0.4
Commercial	32,418.1	0.0	31.4	0.0	32,449.5	30.3
Government	3,312.1	53,794.5	0.0	0.0	57,106.6	53.4
Health	349.6	0.0	0.0	0.0	349.6	0.3
Utility	15,913.8	0.0	783.4	0.0	16,697.2	15.6
Total	52,362.1	53,794.5	822.3	1.0	106,979.8	100.0
% of Total	48.9	50.3	0.8	0.0	100.0	

Table 35
1993 LLRW Activity Shipped for Disposal – by Generator Category and Disposal Class
(curies)

	Disposal Classification					
Generator Category	Class A	Class AH	Class B	Class C	Total	% of Total
Academic	10.6173	0.0000	1.1300	0.0001	11.7474	0.0
Commercial	269.3098	0.0000	19,964.7548	0.0000	20,234.0646	53.1
Government	0.5117	0.1035	0.0000	0.0000	0.6153	0.0
Health	3.0538	0.0000	0.0000	0.0000	3.0538	0.0
Utility	1,382.7790	0.0000	16,437.7283	0.0000	17,820.5073	46.8
Total	1,666.2716	0.1035	36,403.6132	0.0001	38,069.9885	100.0
% of Total	4.4	0.0	95.6	0.0	100.0	

Table 36
Activity Half–Life Distribution of 1993 LLRW Shipped for Disposal – by Generator Category
(curies)

	Half–life Distribution					
Generator Category	< 1 Year	1 Year – < 5 Years	5 Years – < 15 Years	> 15 Years	Total	% of Total
Academic	1.0114	0.1152	7.9891	2.6317	11.7474	0.0
Commercial	12.1389	2.2519	20,196.3620	23.3118	20,234.0646	53.1
Government	0.0000	0.0000	0.0013	0.6140	0.6153	0.0
Health	2.1116	0.0002	0.9163	0.0258	3.0538	0.0
Utility	6,294.9535	7,008.9151	3,816.1603	700.4784	17,820.5073	46.8
Total	6,310.2154	7,011.2824	24,021.4290	727.0617	38,069.9885	100.0
% of Total	16.6	18.4	63.1	1.9	100.0	

Table 37
Activity Half–Life Distribution of 1993 LLRW Shipped for Disposal – by Waste Category
(curies)

Waste Category	Half–life Distribution				Total	% of Total
	< 1 Year	1 Year – < 5 Years	5 Years – < 15 Years	> 15 Years		
DAW–Compacted Bulk Material	4.8533	0.5804	126.9857	8.8892	141.3086	0.4
DAW–Bulk Materials	0.9975	0.2650	1.1294	4.2606	6.6524	0.0
DAW–Compacted Solids	0.3277	2.8291	1.2242	0.9891	5.3702	0.0
DAW–Solids	2.1571	0.2330	111.2030	0.6330	114.2262	0.3
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	16.7000	656.0000	285.0000	328.0000	1,285.7000	3.4
Dewatered Ion Exchange Media	53.3250	224.2500	244.6326	10.4192	532.6267	1.4
Dewatered Filter Media	7.4224	19.1300	13.5049	0.7031	40.7605	0.1
Other Dewatered Sludges	0.0001	0.0000	0.0000	0.5630	0.5631	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.2130	18.7000	1.5100	1.2700	21.6930	0.1
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0519	0.0008	19,957.1528	0.0496	19,957.2551	52.4
Solidified Liquids	0.3550	0.2657	0.1349	10.5375	11.2930	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	5.5082	1.9994	0.3845	0.7126	8.6047	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0060	0.0000	0.0001	0.0006	0.0067	0.0
Irradiated Reactor Components	6,217.0000	6,087.0000	3,270.5770	359.1580	15,933.7350	41.9
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	1.2982	0.0290	7.9900	0.8762	10.1934	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	6,310.2154	7,011.2824	24,021.4290	727.0617	38,069.9885	100.0
% of Total	16.6	18.4	63.1	1.9	100.0	

Table 38

Surface Radiation Level Distribution of 1993 LLRW Volume Shipped for Disposal – by Waste Category

(cubic feet)

Waste Category	Volume					
	Waste Container Radiation Level (millirem/hr)[1]					
	Bkgd[2]	<1	1–<10	10–<100	100–<1000	> 1000
DAW–Compacted Bulk Material	476.3	1,228.2	746.1	1,960.6	122.6	0.0
DAW–Bulk Materials	3,406.8	24,704.7	520.2	0.0	22.5	0.0
DAW–Compacted Solids	1,603.7	1,123.9	1,187.3	55.0	572.0	0.0
DAW–Solids	0.0	53,931.3	7.5	0.0	128.0	0.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	7,068.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	2,557.6
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	1,029.0
Other Dewatered Sludges	0.0	1,452.3	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	130.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	34.8	341.5	30.0	0.0	0.0	0.0
Solidified Liquids	0.7	73.0	4.0	7.5	37.5	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	69.9	321.1	47.1	1,309.9	25.5	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	11.7	48.0	0.0	0.0	0.0	0.0
Irradiated Reactor Components	0.0	0.0	0.0	521.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	3.5	18.4	26.1	15.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Total	5,607.3	83,242.5	2,698.3	3,869.0	7,976.1	3,586.6
% of Total	5.2	77.8	2.5	3.6	7.5	3.4

[1] Measured upon shipment from licensee facilities.

[2] Bkgd means radiation levels external to the waste container are equivalent to background radiation at the point of shipment.

Table 39
Surface Radiation Level Distribution of 1993 LLRW Activity Shipped for Disposal – by Waste Category
(curies)

	Activity					
	Waste Container Radiation Level (millirem/hr)[1]					
Waste Category	Bkgd[2]	<1	1–<10	10–<100	100–<1000	> 1000
DAW–Compacted Bulk Material	85.5816	51.2497	1.3532	2.7372	0.3869	0.0000
DAW–Bulk Materials	1.9875	0.8811	3.6538	0.0000	0.1300	0.0000
DAW–Compacted Solids	0.8273	0.0334	1.2027	0.2929	3.0139	0.0000
DAW–Solids	0.0000	81.3829	0.1420	0.0000	32.7013	0.0000
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	1,285.7000	0.0000
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	532.6267
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	40.7605
Other Dewatered Sludges	0.0000	0.5631	0.0000	0.0000	0.0000	0.0000
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cartridge Filters	0.0000	0.0000	21.6930	0.0000	0.0000	0.0000
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Absorbed Liquids	19,957.0662	0.1798	0.0091	0.0000	0.0000	0.0000
Solidified Liquids	0.0056	0.1399	0.0009	0.2082	10.9385	0.0000
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Incinerator (Incin) Ash	0.4863	0.0993	0.5403	5.8877	1.5911	0.0000
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Biological Waste or Carcasses	0.0036	0.0031	0.0000	0.0000	0.0000	0.0000
Irradiated Reactor Components	0.0000	0.0000	0.0000	15,933.7350	0.0000	0.0000
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sealed Sources	7.6958	2.3226	0.0385	0.1364	0.0000	0.0000
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	20,053.6538	136.8548	28.6335	15,942.9974	1,334.4617	573.3872
% of Total	52.7	0.4	0.1	41.9	3.5	1.5

[1] Measured upon shipment from licensee facilities.

[2] Bkgd means radiation levels external to the waste container are equivalent to background radiation at the point of shipment.

8. 1993 Mixed LLRW Characteristic Data

Massachusetts radioactive materials users reported producing 55,577 cubic feet of mixed waste in 1993. Following various on–site and off–site management activities, 52,692 cubic feet were shipped for disposal. (See Tables 40 and 41.) The majority of mixed waste produced was decommissioning waste (soils) shipped to the Envirocare facility in Clive, Utah. The second largest category of mixed waste produced, liquid scintillation fluid, was incinerated for disposal at out–of–state facilities. The majority of the mixed waste shipped for disposal came from the decommissioning of the U.S. Army Materials Technology Laboratory at the Watertown Arsenal.

Table 40

1993 Mixed LLRW Volume Production Summary – by Generator Category

(cubic feet)

	Acad	Comm	Govt	Health	Utility	Total	% of Total
Produced	606.2	1,145.3	52,711.1	1,114.0	0.0	55,576.6	100.0
LLRW Management							
Eliminated by Treatment (off–site)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eliminated by Treatment (on–site)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incineration for Disposal (on–site)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incineration for Disposal (off–site)	570.7	782.1	0.0	938.0	0.0	2,290.9	4.1
Shipped for Disposal	0.0	0.0	52,692.0	0.0	0.0	52,692.0	94.8
Storage for Decay (off–site)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Storage for Decay (on–site)	25.0	336.8	19.1	26.0	0.0	406.9	0.7
Stored in 1993 for Future Disposal	10.5	26.4	0.0	150.0	0.0	186.9	0.3
Total	606.2	1,145.3	52,711.1	1,114.0	0.0	55,576.6	100.0

Table 41

1993 Mixed LLRW Activity Production Summary – by Generator Category

(curies)

	Acad	Comm	Govt	Health	Utility	Total	% of Total
Produced	0.7804	1.0316	0.1435	4.3514	0.0000	6.3069	100.0
LLRW Management							
Incineration for Disposal (off–site)	0.7573	0.0887	0.0000	2.2784	0.0000	3.1245	49.5
Incineration for Disposal (on–site)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Shipped for Disposal	0.0000	0.0000	0.1035	0.0000	0.0000	0.1035	1.6
Storage for Decay (off–site)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Storage for Decay (on–site)	0.0211	0.9387	0.0400	0.8000	0.0000	1.7998	28.5
Stored in 1993 for Future Disposal	0.0019	0.0041	0.0000	1.2730	0.0000	1.2791	20.3
Total	0.7804	1.0316	0.1435	4.3514	0.0000	6.3069	100.0

Mixed LLRW Production

Production data represents volume and activity information on mixed waste before treatment, and includes waste placed in storage for future off-site disposal, held in storage for decay, and managed by other methods.

Table 42
1993 Mixed LLRW Volume Produced – by Waste and Generator Category
(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	82.5	0.0	0.0	0.0	0.0	82.5	0.1
DAW–Bulk Materials	0.0	202.0	15.0	142.5	0.0	359.5	0.6
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	0.7	52,692.0	0.0	0.0	52,692.7	94.8
DAW–Medical Wastes	0.0	0.0	0.0	26.0	0.0	26.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	1.8	0.0	0.0	0.0	1.8	0.0
Solidified Liquids	0.0	120.0	0.0	0.0	0.0	120.0	0.2
LSF\Vials Organic	513.7	692.7	0.0	909.8	0.0	2,116.2	3.8
LSF\Vials Inorganic	0.0	120.0	0.0	11.6	0.0	131.6	0.2
Other Organic Liquids	10.0	8.1	0.0	0.0	0.0	18.1	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	4.1	16.6	0.0	20.7	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	7.5	0.0	7.5	0.0
Total	606.2	1,145.3	52,711.1	1,114.0	0.0	55,576.6	100.0
% of Total	1.1	2.1	94.8	2.0	0.0	100.0	

Table 43
Activity of 1993 Mixed LLRW Produced – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0390	0.0000	0.0000	0.0000	0.0000	0.0390	0.6
DAW–Bulk Materials	0.0000	0.2000	0.0400	1.2610	0.0000	1.5011	23.8
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0150	0.1035	0.0000	0.0000	0.1185	1.9
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.8000	0.0000	0.8000	12.7
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.6930	0.0000	0.0000	0.0000	0.6930	11.0
Solidified Liquids	0.0000	0.0220	0.0000	0.0000	0.0000	0.0220	0.3
LSF\Vials Organic	0.7214	0.0738	0.0000	1.3273	0.0000	2.1224	33.7
LSF\Vials Inorganic	0.0000	0.0067	0.0000	0.0011	0.0000	0.0077	0.1
Other Organic Liquids	0.0200	0.0211	0.0000	0.0000	0.0000	0.0411	0.7
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.9501	0.0000	0.9501	15.1
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0120	0.0000	0.0120	0.2
Total	0.7804	1.0316	0.1435	4.3514	0.0000	6.3069	100.0
% of Total	12.4	16.4	2.3	69.0	0.0	100.0	

Mixed LLRW Storage for Decay

Table 44

1993 Mixed LLRW Storage for Decay Volume – by Waste and Generator Category

(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	0.0	200.0	15.0	0.0	0.0	215.0	52.8
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	0.7	0.0	0.0	0.0	0.7	0.2
DAW–Medical Wastes	0.0	0.0	0.0	26.0	0.0	26.0	6.4
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	1.1	0.0	0.0	0.0	1.1	0.3
Solidified Liquids	0.0	120.0	0.0	0.0	0.0	120.0	29.5
LSF\Vials Organic	15.0	15.0	0.0	0.0	0.0	30.0	7.4
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	10.0	0.0	0.0	0.0	0.0	10.0	2.5
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	4.1	0.0	0.0	4.1	1.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	25.0	336.8	19.1	26.0	0.0	406.9	100.0
% of Total	6.1	82.8	4.7	6.4	0.0	100.0	

Note: On and off–site total combined.

Table 45

Activity of 1993 Mixed LLRW Storage for Decay – by Waste and Generator Category

(curies)

	Generator Category						
Waste Category	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Bulk Materials	0.0000	0.2000	0.0400	0.0000	0.0000	0.2400	13.3
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0150	0.0000	0.0000	0.0000	0.0150	0.8
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.8000	0.0000	0.8000	44.4
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.6920	0.0000	0.0000	0.0000	0.6920	38.4
Solidified Liquids	0.0000	0.0220	0.0000	0.0000	0.0000	0.0220	1.2
LSF\Vials Organic	0.0011	0.0097	0.0000	0.0000	0.0000	0.0108	0.6
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0200	0.0000	0.0000	0.0000	0.0000	0.0200	1.1
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.0211	0.9387	0.0400	0.8000	0.0000	1.7998	100.0
% of Total	1.2	52.2	2.2	44.4	0.0	100.0	

Note: On and off–site total combined.

Table 46
1993 Mixed LLRW Volume Incinerated for Disposal Off–Site – by Waste and Generator Category

(cubic feet)

Waste Category	Generator Category						
	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	82.5	0.0	0.0	0.0	0.0	82.5	3.6
DAW–Bulk Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.7	0.0	0.0	0.0	0.7	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	488.2	653.3	0.0	909.8	0.0	2,051.4	89.5
LSF\Vials Inorganic	0.0	120.0	0.0	11.6	0.0	131.6	5.7
Other Organic Liquids	0.0	8.1	0.0	0.0	0.0	8.1	0.4
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	0.0	16.6	0.0	16.6	0.7
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	570.7	782.1	0.0	938.0	0.0	2,290.9	100.0
% of Total	24.9	34.1	0.0	40.9	0.0	100.0	

Table 47

Activity of 1993 Mixed LLRW Incinerated for Disposal Off–Site – by Waste and Generator Category

(curies)

Waste Category	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0390	0.0000	0.0000	0.0000	0.0000	0.0390	1.2
DAW–Bulk Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0010	0.0000	0.0000	0.0000	0.0010	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.7183	0.0600	0.0000	1.3273	0.0000	2.1056	67.4
LSF\Vials Inorganic	0.0000	0.0067	0.0000	0.0011	0.0000	0.0077	0.2
Other Organic Liquids	0.0000	0.0211	0.0000	0.0000	0.0000	0.0211	0.7
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.9501	0.0000	0.9501	30.4
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.7573	0.0887	0.0000	2.2784	0.0000	3.1245	100.0
% of Total	24.2	2.8	0.0	72.9	0.0	100.0	

Mixed LLRW Storage

Storage data represents waste placed in storage for future off–site disposal. Data in this section does not include waste stored for complete decay.

Table 48

Mixed LLRW Volume Placed in Storage During 1993 – by Waste and Generator Category

(cubic feet)

Waste Category	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	0.0	2.0	0.0	142.5	0.0	144.5	77.3
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	10.5	24.4	0.0	0.0	0.0	34.9	18.7
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	7.5	0.0	7.5	4.0
Total	10.5	26.4	0.0	150.0	0.0	186.9	100.0
% of Total	5.6	14.1	0.0	80.3	0.0	100.0	

Table 49
Activity of Mixed LLRW Placed in Storage During 1993 – by Waste and Generator Category
(curies)

Waste Category	Generator Category						
	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Bulk Materials	0.0000	0.0000	0.0000	1.2610	0.0000	1.2611	98.6
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.0019	0.0041	0.0000	0.0000	0.0000	0.0060	0.5
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases In Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0120	0.0000	0.0120	0.9
Total	0.0019	0.0041	0.0000	1.2730	0.0000	1.2791	100.0
% of Total	0.1	0.3	0.0	99.5	0.0	100.0	

Table 50

Total Accumulated Mixed LLRW Volume in Storage – by Waste and Generator Category

(cubic feet)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	0.0	2.0	0.0	142.5	0.0	144.5	2.9
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	1.4	0.0	0.0	0.0	1.4	0.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	1.1	0.0	0.0	0.0	1.1	0.0
Solidified Liquids	0.0	270.0	0.0	0.0	0.0	270.0	5.4
LSF\Vials Organic	10.5	564.4	0.0	0.0	0.0	574.9	11.6
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	3,952.5	0.0	0.0	0.0	3,952.5	79.7
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	7.5	0.0	0.0	0.0	7.5	0.2
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	7.5	0.0	7.5	0.2
Total	10.5	4,798.9	0.0	150.0	0.0	4,959.4	100.0
% of Total	0.2	96.8	0.0	3.0	0.0	100.0	

Table 51
Activity of Total Accumulated Mixed LLRW in Storage – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Bulk Materials	0.0000	0.0000	0.0000	1.2610	0.0000	1.2611	0.0
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0160	0.0000	0.0000	0.0000	0.0160	0.0
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0120	0.0000	0.0000	0.0000	0.0120	0.0
Solidified Liquids	0.0000	0.0068	0.0000	0.0000	0.0000	0.0068	0.0
LSF\Vials Organic	0.0019	646.3087	0.0000	0.0000	0.0000	646.3106	10.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	5,798.1052	0.0000	0.0000	0.0000	5,798.1052	89.9
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	2.0273	0.0000	0.0000	0.0000	2.0273	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0120	0.0000	0.0120	0.0
Total	0.002	6,446.476	0.000	1.273	0.000	6,447.751	100.0
% of Total	0.0	100.0	0.0	0.0	0.0	100.0	

Mixed LLRW Shipped for Disposal

Table 52
1993 Mixed LLRW Volume Shipped for Disposal – by Waste and Generator Category
(cubic feet)

Waste Category	Generator Category Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	0.0	52,692.0	0.0	0.0	52,692.0	100.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	52,692.0	0.0	0.0	52,692.0	100.0
% of Total	0.0	0.0	100.0	0.0	0.0	100.0	

Table 53

Activity of 1993 Mixed LLRW Shipped for Disposal – by Waste and Generator Category

(curies)

	Generator Category						
Waste Category	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Bulk Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.0000	0.0000	0.1035	0.0000	0.0000	0.1035	100.0
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.0000	0.0000	0.1035	0.0000	0.0000	0.1035	100.0
% of Total	0.0	0.0	100.0	0.0	0.0	100.0	

Table 54
1993 Mixed LLRW Volume Shipped for Disposal – by Waste Category and Disposal Class

(cubic feet)

Waste Category	Disposal Classification Class AH	Class BH	Class CH	Total	% of Total
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	0.0	0.0	0.0	0.0	0.0
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0
DAW–Solids	52,692.0	0.0	0.0	52,692.0	100.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	0.0	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0
Incinerator Ash	0.0	0.0	0.0	0.0	0.0
Incinerator Ash–Solidified	0.0	0.0	0.0	0.0	0.0
Incinerator Ash–Compressed	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	0.0	0.0	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0
Total	52,692.0	0.0	0.0	52,692.0	100.0
% of Total	100.0	0.0	0.0	100.0	

Table 55

Activity of 1993 Mixed LLRW Shipped for Disposal – by Waste Category and Disposal Class

(curies)

	Disposal Classification				
Waste Category	**Class AH**	**Class BH**	**Class CH**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Bulk Materials	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0
DAW–Solids	0.1035	0.0000	0.0000	0.1035	100.0
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator Ash	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0
Incinerator Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.1035	0.0000	0.0000	0.1035	100.0
% of Total	100.0	0.0	0.0	100.0	

Table 56
1993 Mixed LLRW Volume Shipped for Disposal – by Generator Category and Disposal Class
(cubic feet)

Generator Category	Disposal Classification Class AH	Class BH	Class CH	Total	% of Total
Academic	0.0	0.0	0.0	0.0	0.0
Commercial	0.0	0.0	0.0	0.0	0.0
Government	52,692.0	0.0	0.0	52,692.0	100.0
Health	0.0	0.0	0.0	0.0	0.0
Utility	0.0	0.0	0.0	0.0	0.0
Total	52,692.0	0.0	0.0	52,692.0	100.0
% of Total	100.0	0.0	0.0	100.0	

Table 57
Activity of 1993 Mixed LLRW Shipped for Disposal – by Generator Category and Disposal Class
(curies)

Generator Category	Disposal Classification Class AH	Class BH	Class CH	Total	% of Total
Academic	0.0000	0.0000	0.0000	0.0000	0.0
Commercial	0.0000	0.0000	0.0000	0.0000	0.0
Government	0.1035	0.0000	0.0000	0.1035	100.0
Health	0.0000	0.0000	0.0000	0.0000	0.0
Utility	0.0000	0.0000	0.0000	0.0000	0.0
Total	0.1035	0.0000	0.0000	0.1035	100.0
% of Total	100.0	0.0	0.0	100.0	

Table 58
Activity Half–Life Distribution of 1993 Mixed LLRW Shipped for Disposal – by Generator Category
(curies)

Generator Category	Half–life Distribution < 1 Year	1 Year – < 5 Years	5 Years – < 15 Years	> 15 Years	Total
Academic	0.0000	0.0000	0.0000	0.0000	0.0000
Commercial	0.0000	0.0000	0.0000	0.0000	0.0000
Government	0.0000	0.0000	0.0000	0.1035	0.1035
Health	0.0000	0.0000	0.0000	0.0000	0.0000
Utility	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.1035	0.1035
% of Total	0.0	0.0	0.0	100.0	100.0

Table 59
Activity Half–Life Distribution of 1993 Mixed LLRW Shipped for Disposal – by Waste Category
(curies)

Waste Category	Half–life Distribution				Total
	< 1 Year	1 Year – < 5 Years	5 Years – < 15 Years	> 15 Years	
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000
DAW–Bulk Materials	0.0000	0.0000	0.0000	0.0000	0.0000
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000
DAW–Solids	0.0000	0.0000	0.0000	0.1035	0.1035
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0000
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000
Gases In Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0.0000	0.0000	0.1035	0.1035
% of Total	0.0	0.0	0.0	100.0	100.0

Table 60
Surface Radiation Level Distribution of 1993 Mixed LLRW Volume Shipped for Disposal – by Waste Category
(cubic feet)

Waste Category	Volume					
	Waste Container Radiation Level (millirem/hr)[1]					
	Bkgd[2]	<1	1–<10	10–<100	100–<1000	> 1000
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	52,692.0	0.0	0.0	0.0	0.0
DAW–Medical Wastes	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	0.0	0.0	0.0	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0
Gases in Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	0.0	0.0	0.0	0.0	0.0	0.0
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	0.0	0.0	0.0	0.0
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	52,692.0	0.0	0.0	0.0	0.0
% of Total	0.0	100.0	0.0	0.0	0.0	0.0

[1] Measured upon shipment from licensee facilities.

[2] Bkgd means radiation levels external to the waste container are equivalent to background radiation at the point of generation.

Table 61
Surface Radiation Level Distribution of 1993 Mixed LLRW Activity Shipped for Disposal – by Waste Category
(curies)

Waste Category	Activity					
	Waste Container Radiation Level (millirem/hr)[1]					
	Bkgd[2]	<1	1–<10	10–<100	100–<1000	> 1000
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAW–Bulk Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAW–Solids	0.0000	0.1035	0.0000	0.0000	0.0000	0.0000
DAW–Medical Wastes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sealed Sources	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Medical Isotope Generators	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	0 1035	0.0000	0.0000	0.0000	0.0000
% of Total	0.0	100.0	0.0	0.0	0.0	0.0

[1] Measured upon shipment from licensee facilities.

[2] Bkgd means radiation levels external to the waste container are equivalent to background radiation at the point of generation.

9. 1993 Other Radioactive Waste Characteristic Data

As noted, data on management of liquid and gaseous effluents, and materials returned to suppliers as waste or for recycling, is supplied on a voluntary basis. The data is included in this report for informational purposes. However, since it may be incomplete, it should be interpreted with caution.

Atmospheric Release

Table 62
1993 Volume and Activity of Atmospheric Releases – by Generator Category

Generator Category	Volume (cubic feet)	% of Total	Activity (curies)	% of Total
Academic	0.0	0.0	0.0000	0.0
Commercial	9,028.7	100.0	33.6301	100.0
Government	0.0	0.0	0.0000	0.0
Health	0.0	0.0	0.0000	0.0
Utility	0.0	0.0	0.0000	0.0
Total	9,028.7	100.0	33.6301	100.0

Sewerage Release

Table 63
1993 Volume and Activity Released to Sewerage Systems – by Generator Category

Generator Category	Volume (cubic feet)	% of Total	Activity (curies)	% of Total
Academic	877.1	0.1	1.5436	19.3
Commercial	657,133.8	99.8	3.2487	40.7
Government	2.1	0.0	0.0110	0.1
Health	438.8	0.1	3.1853	39.9
Utility	0.0	0.0	0.0000	0.0
Total	658,451.9	100.0	7.9887	100.0

Transfer to Authorized Recipients

Table 64
1993 Volume and Activity Transferred to Authorized Recipients – by Generator Category

Generator Category	Volume (cubic feet)	% of Total	Activity (curies)	% of Total
Academic	29.1	1.6	3,211.1000	68.9
Commercial	1,384.3	75.0	1,352.0340	29.0
Government	5.2	0.3	6.2101	0.1
Health	427.7	23.2	90.6632	1.9
Utility	0.0	0.0	0.0000	0.0
Total	1,846.2	100.0	4,660.0072	100.0

Table 65

1993 Volume Transferred to Authorized Recipients – by Waste and Generator Category

(cubic feet)

Waste Category	Generator Category						
	Acad	Comm	Govt	Health	Utility	Total	% of Total
DAW–Compacted Bulk Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Bulk Materials	0.0	4.0	0.0	0.0	0.0	4.0	0.2
DAW–Compacted Solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DAW–Solids	0.0	1,226.3	0.0	0.0	0.0	1,226.3	66.4
DAW–Medical Wastes	0.0	0.1	0.0	19.0	0.0	19.1	1.0
Contaminated Metal Objects	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dewatered Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Dewatered Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Ion Exchange Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidified Filter Media	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cartridge Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Solidified Sludges	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absorbed Liquids	0.0	0.0	0.0	3.0	0.0	3.0	0.2
Solidified Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Organic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSF\Vials Inorganic	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organic Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incinerator (Incin) Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Solidified	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Incin Ash–Compressed	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biological Waste or Carcasses	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Irradiated Reactor Components	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Irradiated Materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gases In Sealed Containers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sealed Sources	29.1	153.9	2.4	12.7	0.0	198.1	10.7
Contaminated Oil\Lubricant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Filters	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medical Isotope Generators	0.0	0.0	2.7	393.0	0.0	395.7	21.4
Aqueous Liquids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	29.1	1,384.3	5.2	427.7	0.0	1,846.2	100.0
% of Total	1.6	75.0	0.3	23.2	0.0	100.0	

Table 66
1993 Activity Transferred to Authorized Recipients – by Waste and Generator Category
(curies)

	Generator Category						
Waste Category	**Acad**	**Comm**	**Govt**	**Health**	**Utility**	**Total**	**% of Total**
DAW–Compacted Bulk Material	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
DAW–Bulk Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
DAW–Compacted Solids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
DAW–Solids	0.0000	0.6857	0.0000	0.0000	0.0000	0.7	0.0
DAW–Medical Wastes	0.0000	0.0010	0.0000	1.9700	0.0000	2.0	0.0
Contaminated Metal Objects	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Dewatered Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Dewatered Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Other Dewatered Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Solidified Ion Exchange Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Solidified Filter Media	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Cartridge Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Other Solidified Sludges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Absorbed Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Solidified Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
LSF\Vials Organic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
LSF\Vials Inorganic	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Other Organic Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Incinerator (Incin) Ash	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Incin Ash–Solidified	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Incin Ash–Compressed	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Biological Waste or Carcasses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Irradiated Reactor Components	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Other Irradiated Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Gases in Sealed Containers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Sealed Sources	3,211.1000	1,351.3472	0.2101	9.8920	0.0000	4,572.5	98.1
Contaminated Oil\Lubricant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Gas Filters	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Medical Isotope Generators	0.0000	0.0000	6.0000	78.8012	0.0000	84.8	1.8
Aqueous Liquids	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
Total	3,211.1	1,352.0	6.2	90.7	0.0	4,660.0	100.0
% of Total	68.9	29.0	0.1	1.9	0.0	100.0	

10. 1993 LLRW Shipment Information

The following two tables provide information on LLRW shipments as reported by generators transporting LLRW for disposal during 1993. Shipments shown in Tables 67 and 68 are segregated by three types, based on U.S. Department of Transportation (DOT) and NRC regulations: LSA or strong tight, Type A, and Type B. LSA or Low Specific Activity refers to packages containing low average concentrations of radioactivity, uniformly distributed. Type A and B package designations bear no correlation to NRC Class A and B disposal classifications. Table 67 and 68 shipment totals are not equivalent due to under reporting of shipment destination.

Table 67
1993 LLRW Shipments -- by Shipment Type and Generator Category
(number of shipments)

Type of Shipment	Generator Category Acad	Comm	Govt	Health	Utility	Total
LSA	18	63	87	9	19	196
Type A	24	78	5	25	13	145
Type B	1	7	0	0	5	13
Total	43	148	92	34	37	354

Table 68
1993 LLRW Shipments -- by Generator Category and Destination
(number of shipments)

Generator Category	Return to Supplier	via Broker \Processor	Directly to Disposal	Total
Academic	1	15	10	26
Commercial	11	53	85	149
Government	5	0	88	93
Health	1	21	21	43
Utility	0	19	14	33
Total	18	108	218	344

LSA or strong tight packaging is designed to withstand normal transportation conditions. The limits on radioactive material quantities in an LSA package are such that any risks would be minimal if the material were dispersed during an accident. Type A packages are designed to withstand a higher level of stress (including rough handling); limits on radioactivity in these packages are such that there would be minimal effects on persons or the environment if the contents were dispersed during an accident. Type B packages are designed to withstand stress associated with an accident condition, since the quantities of radioactive materials allowed would have a greater potential hazard than Type A materials.

LLRW shipping/disposal containers vary in size from five to over 95 cubic feet, with 7.5 cubic feet (55 gallon) the most common. Table 69 shows the number and type of containers used to ship LLRW from licensee facilities to processors or disposal sites. Note that this data indicates the types of containers used to transport waste from the point of generation. The data does not reflect the number of containers received at disposal facilities, since processors repackage LLRW prior to final shipment for disposal.

Table 69
Number of Containers Shipped from Licensee Facilities – by Generator Category and Container Type

Generator Category	Container Volume					
	30 Gal. Drum	55 Gal. Drum	B–25 Box	Other[1]	Total	% of Total
Academic	95	175	0	16	286	9.6
Commercial	53	812	78	646	1,589	53.2
Government	0	149	0	534	683	22.9
Health	3	238	0	39	280	9.4
Utility	20	0	0	127	147	4.9
Total	171	1,374	78	1,362	2,985	100.0
% of Total	5.7	46.0	2.6	45.6	100.0	

[1] Other includes: 83, 85, and 89 gallon containers; rail cars; components that acted as a container; and other miscellaneous containers.

Table 70 provides a breakdown of the number of waste containers by radiation level as measured prior to shipment from licensee facilities. As shown, the majority of containers (86.5%) had radiation levels less than 1 millirem per hour. High radiation level containers (>1000 millirem/hour) are shipments of components and irradiated hardware from the utility category.

Table 70
Number of Containers Shipped from Licensee Facilities – by Generator Category and Radiation Level

Generator Category	Surface Radiation Level (millirem/hour)					
	Bkg	Bkg–<1	1–<10	10–<100	100–<1000	>1000
Academic	128	120	38	0	0	0
Commercial	197	1,182	109	50	51	0
Government	1	680	0	2	0	0
Health	70	197	13	0	0	0
Utility	0	15	33	76	5	18
Total	396	2,194	193	128	56	18
% of Total	13.3	73.5	6.5	4.3	1.9	0.6

To minimize potential doses to workers and the public, high radiation packages are placed into special containers, called overpacks, during transport to processors or disposal facilities.

11. Evaluating the 1993 Data for Policy-Making Purposes

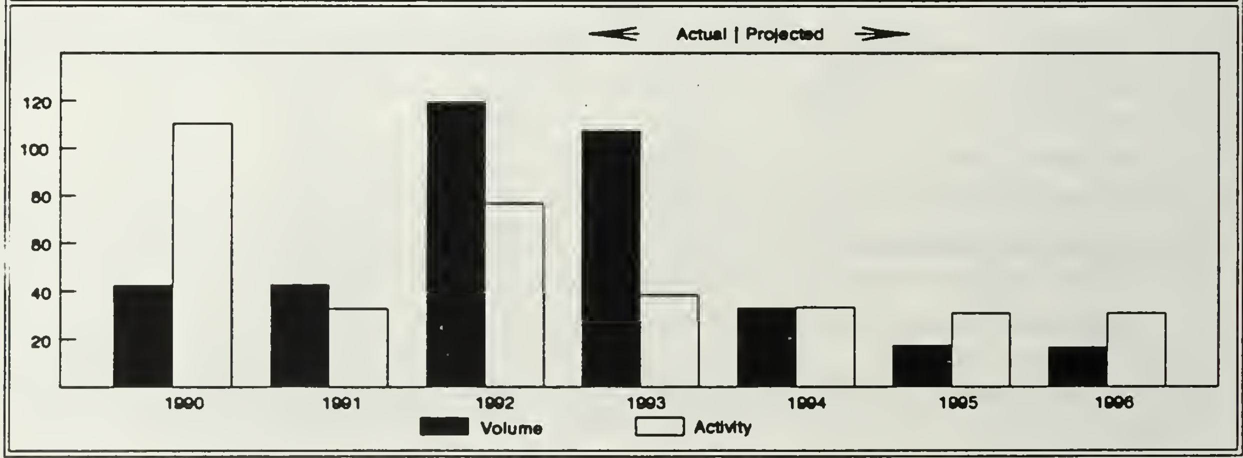
The number of organizations that shipped LLRW out-of-state for disposal decreased from 106 to 78 between 1992 and 1993. This change reflects the decreasing number of NRC license holders in Massachusetts, during that time. The number of NRC licensees declined from approximately 441 to 382. This reduction can be attributed to several factors. One major reason is the recent increase in license fees due to a mandate by the U.S. Congress that NRC operate its licensing programs on a strict cost-recovery basis. Another factor, although less significant, is the merging within the biotechnology and health care generator categories.

The volume of LLRW shipped for disposal decreased by 10% in 1993. As in 1992, LLRW volume shipped for disposal was elevated due to decommissioning waste, which accounted for approximately 86% of LLRW shipped for disposal during 1993; the remaining 14% is attributed to normal, non-decommissioning waste production. For 1993, of the three NRC disposal classes, Class A continued to account for the largest percentage of volume shipped for disposal, namely 99.2%, while Class B and Class C amounted to 0.8% and <0.1%, respectively.

While 1993 LLRW volume was inflated by decommissioning LLRW, radioactivity in LLRW shipped for disposal decreased by 50%. Of the three NRC disposal classes, Class B waste continued to account for the largest percentage of activity (95.6%), while Class A and Class C were 4.4% and <0.1% respectively. For Massachusetts, the amount of activity shipped for disposal consists primarily of an annual base component of tritium waste from Du Pont Medical Products and a variable component (every two to three years) of high activity irradiated hardware shipments from Boston Edison or Yankee Atomic. For 1993, the base component, which decreased from 41,700 to 19,900 curies due to source minimization, accounted for 52% of the activity shipped for disposal while the variable component was zero. One-time decommissioning waste from Yankee Atomic, containing 17,245 curies, accounted for the remaining 48% of activity shipped for disposal.

Figure 12 illustrates how 1993 volume and activity shipped for disposal compares with previous

Figure 12
Historical and Projected LLRW Volume and Activity Shipped for Disposal
(thousands of cubic feet and curies)



years, and shows future projections of LLRW requiring disposal, as reported by generators. Survey responses for 1993 indicate that the amount of normal annual volume requiring disposal is continuing to decrease, and will fall to a level below the 20,000–25,000 cubic feet level projected for this annual volume in last year's report.

Source and Waste Volume Minimization

During 1993, 78 companies reported the shipment of LLRW for disposal. Of the 78, 60 can be classified as small volume generators (shipped less than 100 cubic feet). Figures 13 and 14 show the distribution, by volume and activity, of the number of organizations that shipped LLRW for disposal.

Figure 13
Distribution of Organizations that Shipped LLRW for Disposal During 1993 – by Volume
(number of organizations)

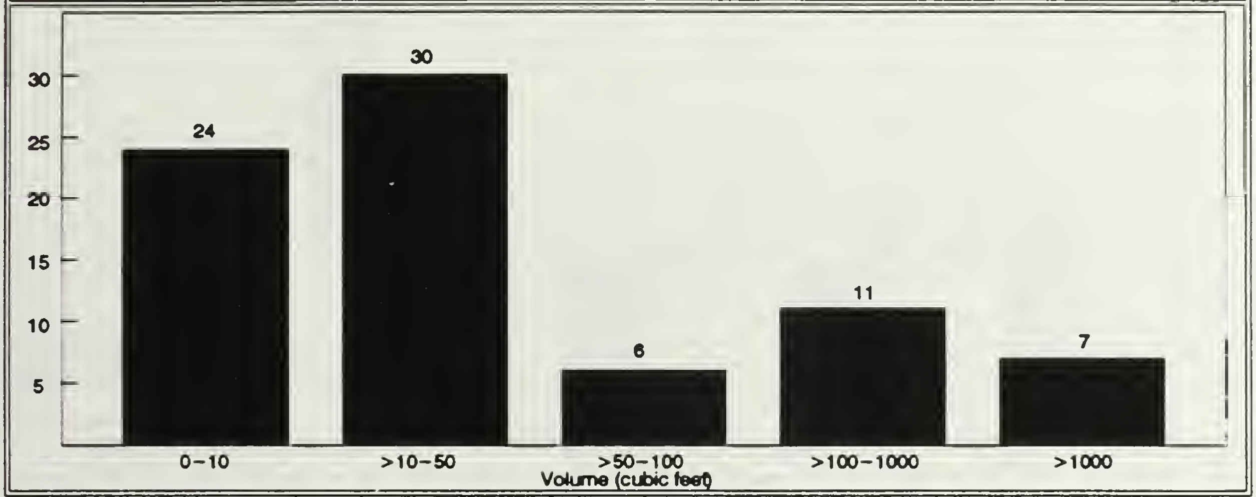
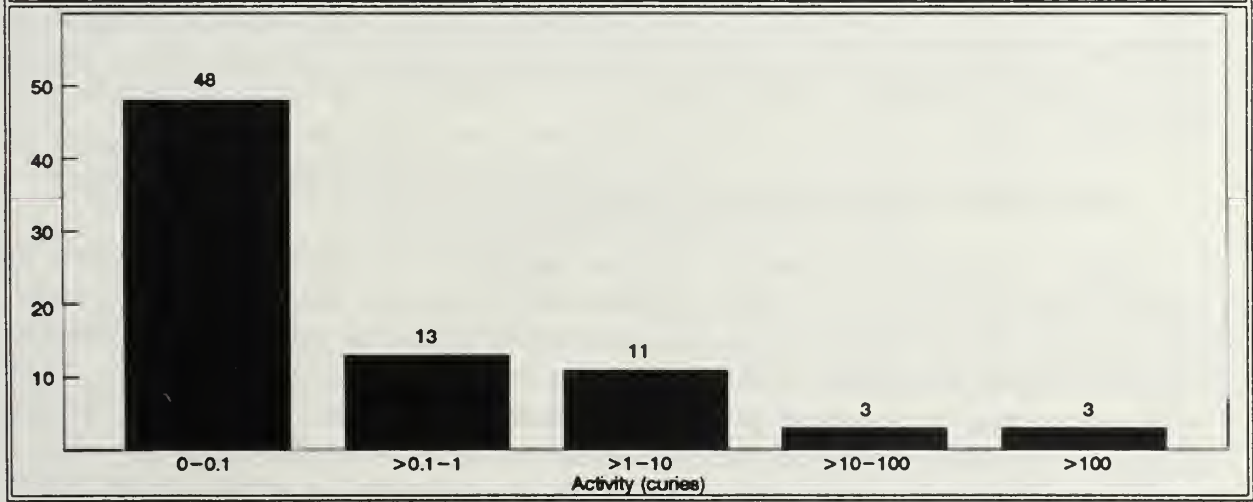
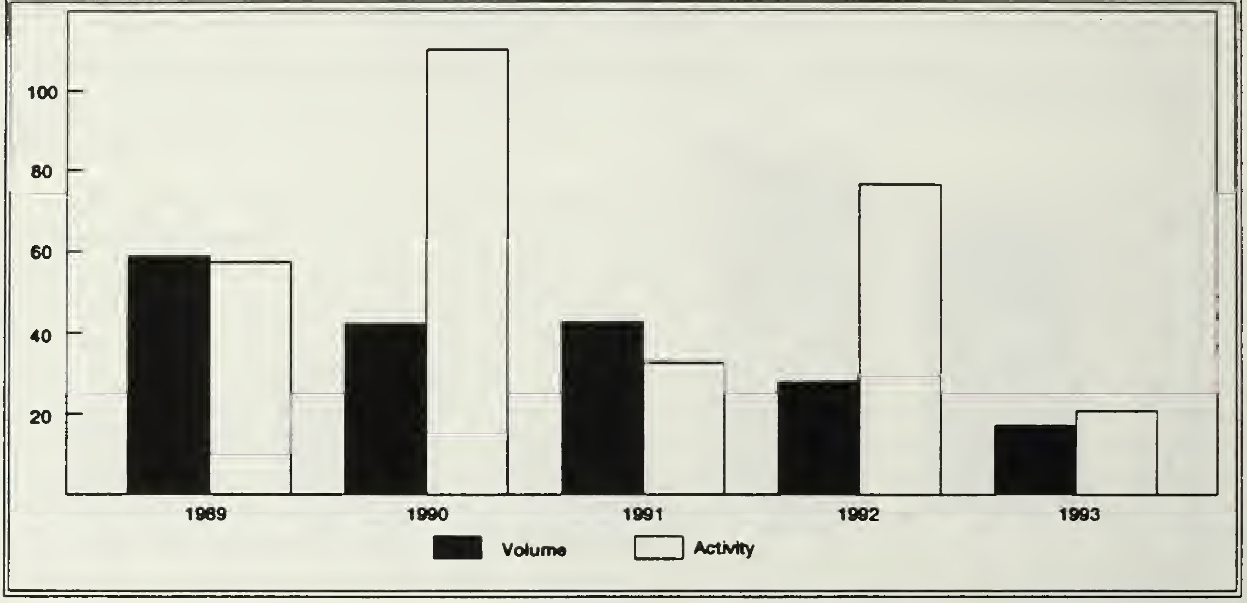


Figure 14
Distribution of Organizations that Shipped LLRW for Disposal During 1993 – by Activity
(number of organizations)



As noted, volume shipped for disposal has been elevated due to several decommissioning projects now in progress. LLRW from these projects has masked the decreasing trend in the state's routine annual waste volume production. Since a few generators produce the vast majority of LLRW requiring disposal, the trend is a reflection of the volume reduction efforts by these companies. Figure 15 shows the amount of volume and activity shipped for disposal between 1989 and 1993, excluding decommissioning waste.

Figure 15
Massachusetts Non–Decommissioning LLRW Volume and Activity Shipped for Disposal
1989–1993
(thousands of cubic feet and curies)

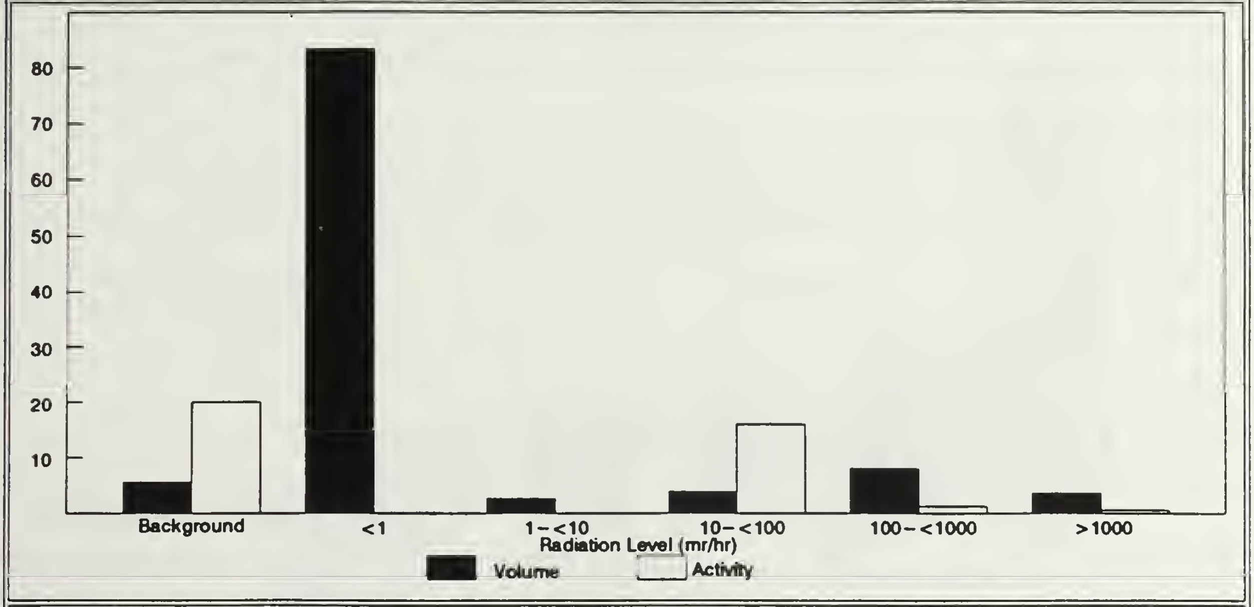


While LLRW volume has decreased by over two–thirds since 1989, as Figure 15 shows, activity has been fluctuating but appears to be decreasing on alternate years. The latter effect is due to a decrease in tritium waste production by Du Pont Medical Products, while the periodic shipments of nuclear power plant irradiated hardware in 1990 and 1992 account for the large activity increases in those years.

Radiological Characteristics of Massachusetts LLRW Shipped for Disposal

Figure 16 presents the distribution of typical radiation levels, measured external to the waste container prior to shipment from licensee facilities. The majority of LLRW volume shipped for disposal (over 80%) emits radiation between a level indistinguishable from background radiation and 1 millirem per hour. Background radiation, which naturally varies from location to location, is defined as the radiation level at a site exclusive of radiation from licensee activities. Natural background radiation in the Boston area (not including indoor radon) is about 65 millirem per year. For comparison, according to the U.S. Environmental Protection Agency, the average annual dose to an individual from both natural and man-made sources is about 360 millirem per year.

Figure 16
Distribution of Volume and Activity of 1993 LLRW Shipped for Disposal
– By Radiation Level
(thousands of cubic feet and curies)



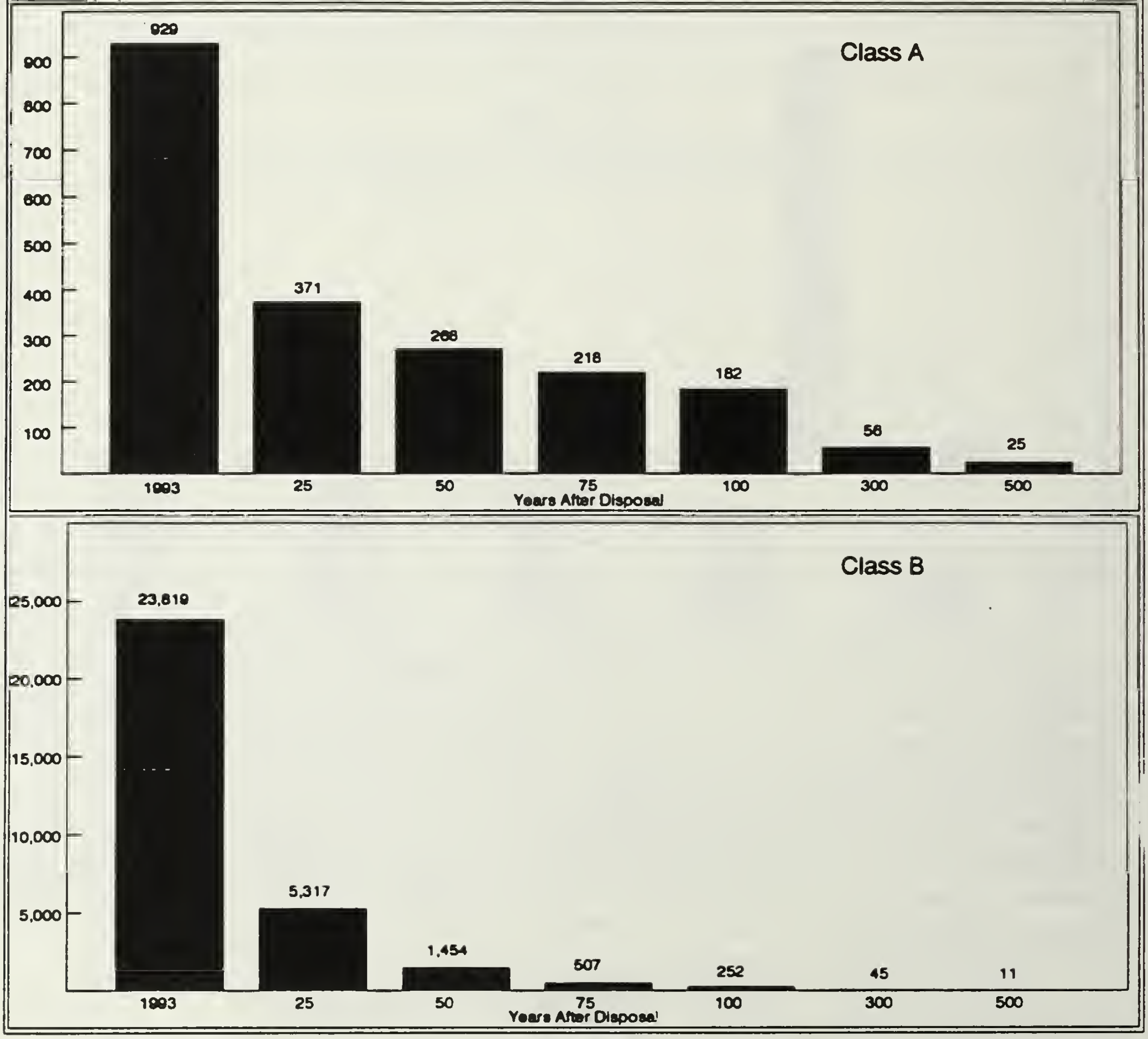
Note: Radiation values are millirem per hour.

Figure 16 illustrates the fact that there is not always a direct relationship between quantity of activity and radiation level emitted. Rather, radiation levels depend upon the type of radionuclide. For example, a shipment of Class B waste (within the left set of bars) containing over 19,900 curies of tritium, emits radiation at a level equivalent to background because tritium emits a low energy particle unable to penetrate the waste container. The last set of bars, at the right side of the graph, includes a Class B shipment of ion exchange media from Pilgrim Nuclear Power Station that emits radiation at a level of up to 50,000 millirem an hour. This waste includes several radionuclides (including Cobalt-60) that emit high energy gamma rays that easily pass through the waste container. However, these high energy emitters will decay to essentially background levels in less than 100 years.

Impact of Radioactive Decay over Time

Figure 17 illustrates how activity in Class A and B LLRW shipped for disposal will decrease in time due to natural radioactive decay. Activity, as defined in these figures, is the number of curies contributed by radionuclides with half-lives greater than five years (radionuclides with smaller half-lives will decay in a much shorter period than the time frame shown on the graph). The Class C activity is not shown because the 0.0001 curies of radium within this waste will not decay significantly over 500 years. The data indicates that the combination of radionuclides within Massachusetts LLRW will experience substantial decay over the life of a Massachusetts disposal facility. For clarity, Class A LLRW is graphed separately from Class B because of large differences in their amounts of activity.

Figure 17
Decay of 1993 Class A and Class B LLRW Radioactivity Shipped for Disposal
(curies)

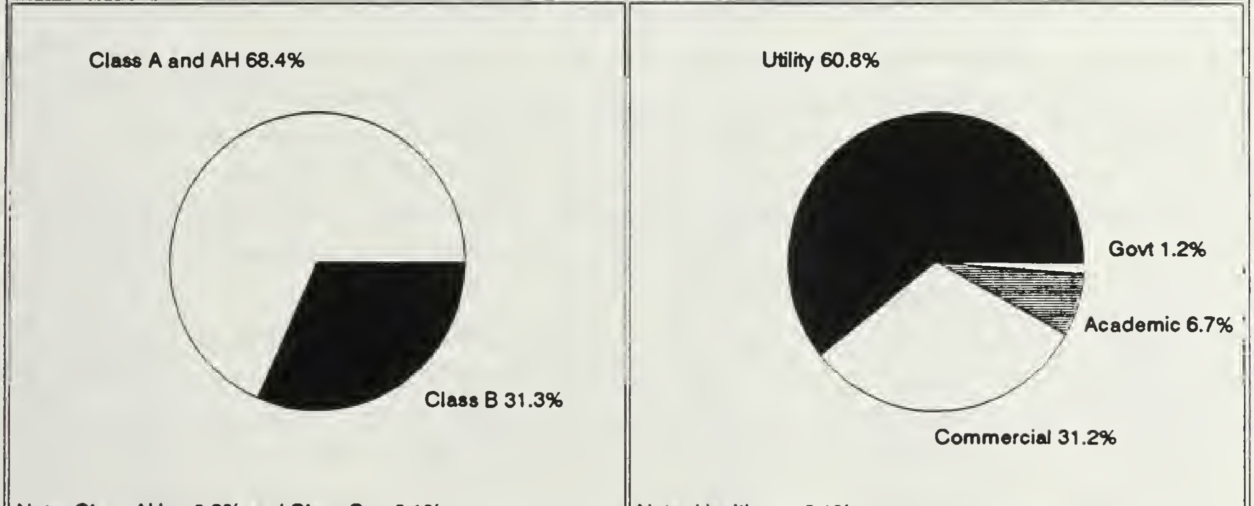


At the time of disposal, Class A waste contained the least number of curies. However, after 500 years, it will contain the most. This is because radionuclides contributing the largest amounts of activity, in Massachusetts Class B waste, have half-lives that allow them to experience significant decay within 500 years. It is interesting to note that one of the largest contributors to activity remaining in all waste classes is Carbon-14, a radionuclide produced naturally in the atmosphere. Table

72 lists radionuclides remaining 100 and 500 years after disposal.

Figure 18 shows the percentage of activity remaining within each disposal class and the amount contributed by each generator category. The data indicates that after 500 years, 68.4% of the activity will be contained in Class A and AH, 31.3% in Class B, and the remaining <0.1% in Class C. By generator category the majority contribution of 60.8% is from the utility category; the second largest contribution of 31.2% is from the commercial category, followed by 6.7% from the academic category. The remaining 1.2% is from the government and health categories, combined.

Figure 18
Percentage of Activity After 500 Years in 1993 LLRW Shipped for Disposal – By Disposal Class and Generator Category



Note: Class AH = 0.3% and Class C < 0.1%

Note: Health = <0.1%

Table 71 shows the percentage of activity remaining over time in 1993 LLRW shipped for disposal. After 100 and 500 years, 1.8% and 0.1% respectively, of the total initial activity will remain.

Table 72 provides a breakdown of radionuclides, and their associated activities, 100 and 500 years after disposal and the generator category contributing the largest quantity of that nuclide to the waste stream. See Appendix B for a breakdown of radionuclides by generator category.

Table 71
Decay of 1993 LLRW Activity[1] Shipped for Disposal – by Disposal Class
(percent of initial activity remaining)

Disposal Class	Initial Activity	Years After Disposal					
		25	50	75	100	300	500
Class A	928.953	40.0	28.8	23.4	19.6	6.0	2.7
Class AH	0.104	100.0	100.0	99.9	99.9	99.9	99.9
Class B	23,819.434	22.3	6.1	2.1	1.1	0.2	0.0
Class C	<0.001	98.9	97.9	96.8	95.8	87.8	80.5
Total Shipped	24,748.491	23.0	7.0	2.9	1.8	0.4	0.1

[1] Radionuclides with greater than 5 year half-lives

The largest contributor to 1993 activity remaining after 500 years of decay is Nickel–63 (60.0%), which comes primarily from nuclear power plants. The second and third largest contributors are Carbon–14 and Uranium–238 from the commercial sector. Carbon–14 is also produced in the atmosphere by the interaction of cosmic rays and nitrogen in the air (a process which produces thousands of curies per year), and is one of several radionuclides (including Potassium–40 and Radium–226) that naturally occur in the human body. The total content of radioactive materials in the body is about 0.000000102 curies.[13]

Table 72
Radionuclides Remaining in 1993 LLRW Shipped for Disposal after 100 and 500 Years
(curies)

Radionuclide	Half–life (years)	100 Years After Disposal	500 Years After Disposal	% of Total At 500 Years	Major Contributor
Ni–63	100	345.774464	21.610904	60.0	Utility
C–14	5,730	9.127367	8.696234	24.1	Commercial
U–238	4,470,000,000	5.507583	5.507583	15.3	Commercial
Ra–226	1,600	0.153525	0.129098	0.4	Commercial
Cl–36	301,000	0.026675	0.026650	0.1	Commercial
U–234	246,000	0.021988	0.021963	0.1	Commercial
Tc–99	213,000	0.016923	0.016901	0.0	Commercial
Ni–59	76,000	0.013219	0.013171	0.0	Utility
Th–232	10,400,000,000	0.009106	0.009106	0.0	Commercial
Pu–239/40	6,560	0.002262	0.002168	0.0	Utility
U–235	704,000,000	0.001280	0.001280	0.0	Commercial
Am–241	432	0.002234	0.001176	0.0	Commercial
Th–230	75,400	0.001099	0.001095	0.0	Commercial
Cs–137	30	1.969356	0.000203	0.0	Commercial
Pu–238	88	0.000669	0.000028	0.0	Utility
Sr–90	29	0.087591	0.000006	0.0	Utility
H–3	12	72.010377	0.000000	0.0	Commercial
Pb–210	22	0.000558	0.000000	0.0	Commercial
Pu–241	14	0.005697	0.000000	0.0	Utility
Cm–234/44	17	0.000009	0.000000	0.0	Utility
Kr–85	11	0.047093	0.000000	0.0	Commercial
Ba–133	11	0.000112	0.000000	0.0	Commercial
Co–60	5	0.007404	0.000000	0.0	Utility
Total		434.786591	36.037567	100.0	

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[13] Shapiro, J. Radiation Protection: A Guide for Scientists and Physicians. Harvard University Press ,Cambridge, MA, 1972.

Projections

The annual survey requests volume and activity projections for three years after the survey year; Table 73 summarizes projections for 1994, 1995, and 1996. The projections reflect an elevation in waste volume in 1994 due to component removal (Yankee Atomic) and decommissioning projects (Texas Instruments and U.S. Army), which are expected to be completed in mid–1994. However, it is possible that Texas Instruments' remediation efforts may result in additional waste requiring disposal after 1994, depending upon the results of radiological surveys conducted prior to NRC license termination.

After 1994, the data indicates the annual amount of LLRW requiring disposal in a licensed facility will fall below the Board's 1992 projection of 20,000–25,000 cubic feet to a value less than 20,000 cubic feet. This decrease will be due to the termination of operational waste production by the Yankee Rowe nuclear power plant and the completion of a recycling program by Nuclear Metals, Inc., which is anticipated to reduce their annual LLRW generation rate. However, this decline may not transpire if generators decide not to have their waste treated by out–of–state processors prior to storing it on site for future disposal. The Management Board will monitor any changes in LLRW management activities that may occur as a result of a lack of disposal facility access.

Activity in LLRW is expected to continue to fluctuate, as in the past, depending upon the operating practices of the Pilgrim nuclear power plant and major commercial producers. The Management Board will continue to evaluate volume and activity projections from radioactive material users to confirm and update its projections.

Table 73

Volume and Activity Projections for LLRW to be Shipped for Disposal – by Generator Category and Waste Type

Generator	Volume (cubic feet)			Activity (curies)		
Category	1994	1995	1996	1994	1995	1996
Process						
Academic	760.5	363.0	363.0	2.7	2.8	2.0
Commercial	11,784.9	10,965.6	10,161.7	30,137.5	30,145.1	30,140.9
Government	904.8	8.9	13.6	0.1	0.2	0.2
Health	497.1	405.2	397.7	1.6	1.6	1.5
Utility	6,262.4	5,446.6	5,446.6	571.9	546.9	546.9
Process Total	20,209.8	17,189.3	16,382.6	30,713.8	30,696.6	30,691.4
Decommissioning	12,607.5	0.0	0.0	2,429.5	0.0	0.0
Total	32,817.3	17,189.3	16,382.6	33,143.3	30,696.6	30,691.4

12. Appendices

Appendix A: Massachusetts Radioactive Waste Producer Information

Table A-1: Inventory of Organizations That Produced Radioactive Waste During 1993

Table A-2: 1993 Radioactive Waste Producer Volume and Activity Management Summary

Table A-3: Ranking by Volume of Organizations That Shipped LLRW for Disposal During 1993

Table A-4: Ranking by Activity of Organizations That Shipped LLRW for Disposal During 1993

Table A-5: 1993 LLRW Volume and Activity Shipped for Disposal - By County

Appendix B: Radioactivity Information

Table B-1: Inventory of Radionuclides With Half-Lives of 90 Days or Less Contained in 1993 LLRW Shipped for Disposal - by Generator Category

Table B-2: Inventory of Radionuclides With Half-Lives Greater Than 90 Days and Less Than Five Years Contained in 1993 LLRW Shipped for Disposal - by Generator Category

Table B-3: Inventory of Radionuclides With Greater Than Five Year Half-Lives Contained in 1993 LLRW Shipped for Disposal - by Generator Category

Table B-4: Inventory of Radionuclides With Greater Than Five Year Half-Lives Contained In 1993 LLRW Shipped for Disposal - by Disposal Class

Table A–1
Inventory of Organizations That Produced Radioactive Waste During 1993

County[1]	City	Organization	Reason for use of Radioactive Materials
Barnstable	Falmouth	Falmouth Hospital	Diagnostic nuclear medicine
Barnstable	Hyannis	Cape Cod Hospital	Diagnostic nuclear medicine
Barnstable	Hyannis	Chiotellis, Phillip	Diagnostic nuclear medicine
Barnstable	Woods Hole	Marine Biological Laboratory	Basic biomedical research and education
Barnstable	Woods Hole	Woods Hole Oceanographic Institute	Marine biology research
Berkshire	Great Barrington	Fairview Hospital	Nuclear medicine
Berkshire	North Adams	North Adams Regional Hospital	Nuclear medical procedures
Berkshire	North Adams	Sprague Co.	Decommissioning of an industrial facility
Berkshire	Pittsfield	Berkshire Medical Center	Medical use
Berkshire	Pittsfield	Hillcrest Hospital	Nuclear medicine
Berkshire	Williamstown	Williams College	Teaching and research
Bristol	Attleboro	Sturdy Memorial Hospital	Diagnostic nuclear medicine
Bristol	Attleboro	Texas Instruments	Remediation of a former radioactive waste burial site
Bristol	Dartmouth	Massachusetts, University of	Academic research
Bristol	Fall River	Charlton Memorial Hospital	Diagnostic nuclear medicine
Bristol	Fall River	St Anne's Hospital	Diagnostic nuclear medicine
Bristol	Mansfield	Clinical Science Laboratory, Inc.	In–vitro diagnostic testing
Bristol	New Bedford	St Luke's Hospital	Clinical nuclear medicine
Bristol	Norton	Wheaton College	Radioimmunoassay
Bristol	N. Attleboro	Mallinckrodt Medical, Inc.	Manufacture and distribution of radiopharmaceuticals for medical diagnosis and therapy
Bristol	Swansea	Tilcon Capaldi Inc.	Measurement of moisture content and density of construction materials
Bristol	Taunton	Morton Hospital and Medical Center	Diagnostic nuclear medicine
Dukes	Oak Bluffs	Martha's Vineyard Hospital	License terminated
Essex	Andover	Eisai Research Institute	R&D operations using biological assays
Essex	Beverley	Varian Associates	Manufacture of electron tubes
Essex	Beverly	Beverly Hospital	Clinical nuclear medicine
Essex	Beverly	New England Biolabs, Inc.	Biotech. applications: DNA sequencing, enzyme assays, protein and nucleic acid labelling
Essex	Beverly	Salem & Beverly Water Supply Board	Gas chromatography

Table A–1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Essex	Danvers	Amicon, Inc.	In-vitro laboratory studies
Essex	Danvers	Diagnostic Management Services, Inc.	Nuclear medicine studies
Essex	Danvers	Osram Sylvania, Inc.	Receipt, storage, and distribution of lamps and lamp products
Essex	Gloucester	Addison Gilbert Hospital	Clinical nuclear medicine
Essex	Haverhill	Hale Hospital	Clinical nuclear medicine
Essex	Lawrence	Lawrence General Hospital	Diagnostic nuclear medicine
Essex	Lynn	AtlantiCare Medical Center	Clinical nuclear medicine
Essex	Methuen	Holy Family Hospital and Medical Center	Medical diagnostic imaging and treatment
Essex	Newburyport	Anna Jaques Hospital	Diagnosis and therapy
Essex	N. Andover	AT & T Network Systems	Leak testing of components, measurement of thickness
Essex	N. Andover	Mediq Imaging Services, Inc.	Diagnostic imaging, instrument calibration
Essex	N. Andover	RTS Technology, Inc.	Manufacture of sealed sources for radiation therapy and industrial radiography
Essex	Salem	EG&G, Inc.	Development, manufacture, testing, and distribution of electron tubes
Essex	Salem	Salem Hospital	Diagnostic nuclear medicine
Franklin	Greenfield	Franklin Medical Center	Diagnostic imaging
Franklin	Rowe	Yankee Atomic Electric Co.	Maintaining a nuclear power plant undergoing decommissioning; environmental lab. ops.
Franklin	Turners Falls	Interior, Department of the	Fish physiology research
Hampden	Chicopee	Our Lady of the Elms College	Teaching and research
Hampden	Holyoke	Holyoke Hospital	Diagnostic nuclear medicine
Hampden	Holyoke	Providence Hospital	Nuclear medicine imaging
Hampden	Ludlow	Ludlow Hospital	Diagnostic nuclear medicine
Hampden	Palmer	Wing Memorial Hospital	Nuclear medicine imaging
Hampden	Springfield	Baystate Medical Center	Diagnostic nuclear medicine, brachytherapy, and radioimmunoassay
Hampden	Springfield	Cameo Diagnostic Center, Inc.	Diagnostic nuclear medicine
Hampden	Springfield	INS Corporation	Laundering of protective clothing worn by radiation workers
Hampden	Springfield	Mercy Hospital	Medical imaging studies
Hampden	Westfield	Noble Hospital	Nuclear medicine imaging
Hampshire	Amherst	Amherst College	Research and teaching

Table A–1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Hampshire	Amherst	Massachusetts, University of	Basic research and teaching
Hampshire	Northampton	Cooley Dickinson Hospital	Medical imaging studies
Hampshire	Northampton	Smith College	Research and teaching, gas chromatography
Hampshire	South Hadley	Mount Holyoke College	Basic research and teaching
Middlesex	Arlington	Symmes Hospital	Clinical nuclear medicine
Middlesex	Ashland	Kidde–Fenwal, Inc.	Manufacture of smoke detectors
Middlesex	Ayer	Deaconess–Nashoba Hospital	Diagnostic nuclear medicine
Middlesex	Bedford	CIS–US, Inc.	Manufacture and distribution of radiopharmaceuticals
Middlesex	Bedford	Collaborative Biomedical Products, Inc.	Biological assays
Middlesex	Bedford	Millipore Corporation	Protein labelling for R&D of filtration media, measurement of thickness
Middlesex	Bedford	V A Hospital (ENRM)	Geriatric research, sample analysis, basic and applied research
Middlesex	Billerica	Du Pont Merck Pharmaceutical Co.	Manufacture of radiopharmaceuticals, industrial and nuclear medicine sources
Middlesex	Billerica	E. I. Du Pont De Nemours & Co.	Manufacture of research compounds and diagnostic kits
Middlesex	Billerica	E. I. Du Pont De Nemours & Co.	Waste generated prior to 1991 from the manufacture of research and industrial sources
Middlesex	Burlington	Amersham Corporation	Manufacturing of sealed sources for industrial radiography
Middlesex	Burlington	Lahey Clinic Medical Center	Diagnostic nuclear medicine
Middlesex	Burlington	M/A–COM, Inc.	Waste byproducts from decommissioning activities
Middlesex	Cambridge	Advanced Magnetics, Inc.	R&D of pharmaceuticals
Middlesex	Cambridge	Alkermes Incorporated	R&D of pharmaceuticals
Middlesex	Cambridge	Applied bioTechnology, Inc.	Development of cancer diagnostic assays
Middlesex	Cambridge	Arthur D. Little, Inc.	Toxicology research and testing; sample analysis
Middlesex	Cambridge	BASF Bioresearch Corp.	R&D of potential therapeutic treatments for human disorders (immunology and oncology)
Middlesex	Cambridge	Biogen, Inc.	Biotechnology R&D
Middlesex	Cambridge	Bioran Medical Laboratory	Medical laboratory testing
Middlesex	Cambridge	BioSurface Technology, Inc.	Radiolabeling of materials, irradiator for treatment of cells
Middlesex	Cambridge	Boston Heart Foundation	Clinical nuclear medicine, research
Middlesex	Cambridge	Cambridge Hospital	Diagnostic nuclear medicine
Middlesex	Cambridge	Cambridge Neuroscience Research	Bioresearch

Table A–1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Middlesex	Cambridge	Charles Stark Draper Lab, Inc.	Radiation hardness testing of electronic and mechanical components
Middlesex	Cambridge	CytoMed, Inc.	Bioassay tracers, molecular biological probes, radioimmunoassay
Middlesex	Cambridge	Genesis Pharmaceuticals, Inc.	License terminated
Middlesex	Cambridge	Genetics Institute	R&D
Middlesex	Cambridge	ImmuLogic Pharmaceutical Corp.	Biomedical research, sterilization, and cell inactivation
Middlesex	Cambridge	ImmunoGen, Inc.	Biochemical and biomedical research
Middlesex	Cambridge	Massachusetts Institute of Technology	Teaching and research
Middlesex	Cambridge	Matritech, Inc.	Cancer diagnostic research, assay development, basic molecular biology research activities
Middlesex	Cambridge	Metasyn, Inc.	Pharmaceutical R&D of MRI contrasting agents
Middlesex	Cambridge	Metpath, Inc.	License terminated
Middlesex	Cambridge	Mt. Auburn Hospital	Nuclear medicine
Middlesex	Cambridge	MYCO Pharmaceuticals Inc.	Molecular biology, biochemical research, DNA analysis, enzyme assays
Middlesex	Cambridge	Oravax, Inc	Investigation of vaccines through the mucosal system
Middlesex	Cambridge	Osteo Arthritis Sciences	Biotechnology R&D
Middlesex	Cambridge	PharmaMar USA, Inc.	Biological research
Middlesex	Cambridge	Procept, Inc.	Biotechnology research: protein labeling, DNA labeling & sequencing, etc.
Middlesex	Cambridge	Protein Engineering Corp.	R&D of therapeutic and diagnostic products
Middlesex	Cambridge	Repligen Corporation	Biotechnology related research
Middlesex	Cambridge	T Cell Sciences, Inc.	R&D of therapeutics and diagnostic reagents for use in autoimmune diseases and cancers
Middlesex	Cambridge	Therion Biologics Corporation	Biotechnology facility using molecular biological and protein chemistry techniques
Middlesex	Cambridge	Transkaryotic Therapies, Inc.	Molecular biological probes, radioimmunoassays
Middlesex	Cambridge	Vertex Pharmaceuticals	DNA sequencing, R&D of human pharmaceuticals
Middlesex	Cambridge	Virus Research Institute	R&D of vaccines and therapeutic drugs against infectious diseases
Middlesex	Cambridge	Whitehead Institute for Biomedical Research	Biomedical research
Middlesex	Concord	Emerson Hospital	Diagnostic and therapeutic nuclear medicine
Middlesex	Concord	Nuclear Metals, Inc.	Melting, alloying, casting, extruding, machining and grinding depleted uranium.
Middlesex	Concord	Oxford Analytical, Inc.	Distribution and servicing of XRF analyzers
Middlesex	Everett	Whidden Memorial Hospital	Clinical nuclear medicine

Table A-1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Middlesex	Framingham	Gene-Trak Systems	R&D of DNA/RIA diagnostic products for clinical and food market
Middlesex	Framingham	Genzyme Corp.	Molecular biology, manufacture of diagnostic test kits
Middlesex	Framingham	Metrowest Medical Center	Diagnostic nuclear medicine
Middlesex	Haverhill	IMI, Inc.	Examination of multi-layer printed circuit boards
Middlesex	Hopkinton	Creative Biomolecules, Inc.	Biotechnology R&D; animal studies
Middlesex	Hopkinton	Seragen, Inc.	Product characterization
Middlesex	Hudson	Digital Equipment Corp.	License terminated
Middlesex	Lexington	AutoImmune, Inc.	Cellular bioassay
Middlesex	Lexington	Environmental Protection Agency	Gas chromatography, lead paint analysis
Middlesex	Lexington	Fuji Immunopharmaceuticals Corp.	DNA sequencing, metabolic labelling of cells, thymidine uptake proliferation assays
Middlesex	Lexington	Interneuron Pharmaceuticals Inc.	Biochemical assays
Middlesex	Lexington	Repligen Sandoz Research Corp.	Radiolabelling and DNA sequencing
Middlesex	Lexington	W.R. Grace & Co.	RIA assays
Middlesex	Lowell	Lowell General Hospital	Diagnostic and therapeutic nuclear medicine
Middlesex	Lowell	Lowell, University of Massachusetts	Research and teaching
Middlesex	Lowell	St Joseph's Hospital	Diagnostic and therapeutic nuclear medicine
Middlesex	Malden	Charm Sciences, Inc.	Manufacture of In-vitro test kits for food stuffs
Middlesex	Malden	Enzyme Center	Manufacture of I-125 test kits
Middlesex	Malden	Malden Hospital	Diagnostic nuclear medicine
Middlesex	Marlborough	Digital Equipment Corp.	Testing of solid state devices
Middlesex	Marlborough	Marlborough Hospital	Diagnostic nuclear medicine
Middlesex	Marlborough	Optical Corporation of America	Manufacture of optical equipment
Middlesex	Medford	Lawrence Memorial Hospital of Medford	Clinical nuclear medicine
Middlesex	Melrose	Melrose\Wakefield Hospital	Diagnostic nuclear medicine
Middlesex	Middlesex	Ariad Pharmaceuticals, Inc.	Biological research
Middlesex	Middlesex	Polaroid Corporation	Quality control of coating operations
Middlesex	Milton	Milton Hospital	Diagnostic nuclear medicine, treatment of hyperthyroidism
Middlesex	Natick	Army, Department of	R&D (military equipment, materials, processes) as defined in 10CFR30.4

Table A–1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Middlesex	Natick	Boston Fertility Lab, Inc.	In–vitro diagnostic testing
Middlesex	Natick	Imaging Associates, Inc.	Diagnostic nuclear medicine
Middlesex	Newton	Cellcor, Inc.	Biomedical research, cancer and infectious disease treatment diagnostics
Middlesex	Newton	Newton–Wellesley Hospital	Diagnostic nuclear medicine
Middlesex	Somerville	Somerville Hospital	Diagnostic nuclear medicine
Middlesex	Stoneham	New England Memorial Hospital	Diagnostic nuclear medicine
Middlesex	Sudbury	Raytheon Company	Electronics research and development
Middlesex	Waltham	Brandeis University	Basic research
Middlesex	Waltham	Collaborative Research, Inc.	Molecular biology research
Middlesex	Waltham	Digital Scintigraphics	Diagnostic nuclear medicine
Middlesex	Waltham	Eunice Kennedy Shriver Center	Biomedical research and clinical assays
Middlesex	Waltham	Hemagen Diagnostics, Inc.	Analysis of urine specimens
Middlesex	Waltham	Panametrics, Inc.	Calibration of spacecraft instruments
Middlesex	Waltham	Raytheon Company	Decommissioning of thermionic electron tube manufacturing facilities
Middlesex	Waltham	Skinner & Sherman Laboratories	Analysis of soil samples
Middlesex	Waltham	Waltham/Weston Hospital and Medical Center	Clinical nuclear medicine
Middlesex	Walthan	SmithKline Beecham Clinical Laboratory	In–vitro diagnostic testing
Middlesex	Watertown	Army, Department of	Facility decommissioning
Middlesex	Watertown	Vicam	R&D of food analysis test kits
Middlesex	Wilmington	New England Pathology Services	In–vitro biomedical testing
Middlesex	Wilmington	Textron Defense Systems	Licensed activities in the process of being terminated
Middlesex	Winchester	Health & Human Services, Department of	Regulatory and survey sample analysis, R & D
Middlesex	Winchester	Winchester Hospital	Diagnostic and therapeutic nuclear medicine
Middlesex	Winthrop	Winthrop Hospital	Clinical nuclear medicine
Middlesex	Woburn	Arcturus Pharmaceutical Corporation	Dermatology pharmaceuticals research
Middlesex	Woburn	Biotechnology Management Association, Inc.	DNA amplification R&D and testing of reagents for use in biotechnology research
Middlesex	Woburn	GENTEST Corporation	Study of in–vitro drug metabolism
Middlesex	Woburn	Syncor International Corporation	Compounding and distribution of radiopharmaceuticals for medical use

Table A–1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Middlesex	Woburn	Toxikon Corporation	Research
Middlesex	Woburn	Vazorx Inc.	R&D as defined in 10 CFR 30
Norfolk	Braintree	Clean Harbors Environmental Services, Inc.	Instrument calibration, 'spike' soil samples
Norfolk	Canton	Organogenesis, Inc.	R&D of medical devices
Norfolk	Franklin	Thermo Environmental Instruments	Repair of instruments
Norfolk	Medfield	Strichman Medical Equipment	Test and calibration of medical equipment
Norfolk	Needham	Glover Memorial Hospital	Medical diagnosis
Norfolk	Norfolk	Southwood Community Hospital	Diagnostic nuclear medicine
Norfolk	Norwood	Factory Mutual Research Corp.	Industrial radiography
Norfolk	Norwood	Norwood Hospital	Diagnostic and therapeutic nuclear medicine
Norfolk	Quincy	Quincy City Hospital	Diagnostic nuclear medicine
Norfolk	Randolph	Ares Advanced Technology, Inc.	Molecular biology, sequencing, reagent labelling, immunoassay
Norfolk	Randolph	Serono Laboratories, Inc.	Quality control analysis, some R&D activities
Norfolk	Stoughton	Biomedical Technologies, Inc.	Preparation of I–125 labelled compounds
Norfolk	Walpole	Ciba Corning Diagnostics Corp.	Manufacture, R&D of immunodiagnostic kits and reagents
Norfolk	Wellesley	Wellesley College	Faculty research, student teaching
Norfolk	Westwood	Behring Diagnostics	Development of medical diagnostic products
Norfolk	Westwood	Damon Clinical Laboratories, Inc.	In–vitro testing
Norfolk	Weymouth	South Shore Hospital	Diagnostic nuclear medicine
Plymouth	Bridgewater	Bridgewater State College	Research and training
Plymouth	Brockton	Advacare Management Services	Nuclear medicine testing
Plymouth	Brockton	Brockton Hospital	Diagnostic nuclear medicine
Plymouth	Brockton	Cardinal Cushing General Hospital	Diagnostic procedures, thyroid therapies, treatment of bone metastatic disease
Plymouth	Duxbury	Battelle Memorial Institute	Primary productivity studies
Plymouth	Plymouth	Bartlett Nuclear, Inc.	Mobile decontamination services for nuclear power plants
Plymouth	Plymouth	Boston Edison Co.	Production of electricity
Plymouth	Plymouth	Jordan Hospital	Diagnostic imaging
Plymouth	Wareham	Springborn Laboratories, Inc.	Tracer for ID and quantitation of environmental degradation and aquatic toxicology studies

Table A-1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Plymouth	Wareham	Tobey Hospital	Diagnostic nuclear medicine
Suffolk	Boston	Angell Memorial Animal Hospital	Animal therapy and diagnostics
Suffolk	Boston	Beth Israel Hospital	Biomedical research, nuclear medicine, radiation therapy, endocrinology, clinical chemistry
Suffolk	Boston	Boston Biomedical Research Institute	Radiolabeling to define biological reactions and the structure of biological organizations
Suffolk	Boston	Boston City Hospital	Nuclear medicine, biomedical research, clinical procedures R&D
Suffolk	Boston	Boston College	Teaching and research
Suffolk	Boston	Boston University	Research and instruction
Suffolk	Boston	Boston University Medical Center	Medical research, patient care
Suffolk	Boston	Brigham & Women's Hospital	Patient care, research, service, and teaching
Suffolk	Boston	Bunker Hill Community College	Milking 2/3 week old generators for QC of eluate, use of point sources for QC cameras
Suffolk	Boston	Center for Blood Research	R&D of laboratory tracer studies in-vitro and in-vivo
Suffolk	Boston	Children's Hospital	Medical research, diagnosis, and therapy
Suffolk	Boston	Dana-Farber Cancer Institute	Cancer research, diagnosis, and therapy
Suffolk	Boston	Du Pont Medical Products	Production of tracer compounds, used for medical, industrial, and research purposes
Suffolk	Boston	Faulkner Hospital	Imaging, uptake, dilution, and radioimmunoassay procedures
Suffolk	Boston	Forsyth Dental Center	Biomedical research
Suffolk	Boston	Harvard University	Medical research and student teaching
Suffolk	Boston	Joslin Diabetes Center	Biomedical research/clinical assays
Suffolk	Boston	Massachusetts College of Pharmacy	Laboratory experiments for instruction of students and biological research
Suffolk	Boston	Massachusetts Eye & Ear Infirmary	Research
Suffolk	Boston	Massachusetts General Hospital	Medical diagnosis and therapy, biomedical research
Suffolk	Boston	Massachusetts, University of	Teaching and basic research
Suffolk	Boston	New England Aquarium	Basic and applied research
Suffolk	Boston	New England Baptist Hospital	Clinical nuclear medicine
Suffolk	Boston	New England Deaconess Hospital	Medical research
Suffolk	Boston	New England Medical Center	Diagnostic and therapeutic medical applications, medical research
Suffolk	Boston	Nissin Molecular Biology Institute, Inc.	S-35 labelling
Suffolk	Boston	Northeastern University	Research and education in biology, chemistry, pharmacology, and physics

Table A-1

Inventory of Organizations That Produced Radioactive Waste During 1993

(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Suffolk	Boston	Schepens Eye Research Institute	Biomedical research
Suffolk	Boston	Simmons College	Physiological and molecular DNA research
Suffolk	Boston	Spaulding Rehabilitation Hospital	Clinical nuclear medicine
Suffolk	Boston	St Elizabeth's Hospital	Nuclear medicine, biological research
Suffolk	Boston	Tufts University School of Medicine	Biomedical research and teaching
Suffolk	Boston	USDA Human Nutrition Research Center	Medical research
Suffolk	Boston	V A Medical Center, Boston	Medical research, sample analysis, nuclear medicine, and radiation therapy
Suffolk	Charlestown	Diacrin, Inc.	Biomedical research
Suffolk	Dedham	American Red Cross Blood Services	Bone marrow transplant matching, irradiation of blood products
Suffolk	Dorchester	Camey Hospital	Clinical nuclear medicine
Suffolk	Medford	Tufts University	Laboratory research
Worcester	Clinton	LFE Industrial Systems Corp.	Sealed sources returned from customers
Worcester	Fitchberg	Fitchburg State College	Research in positron annihilation spectroscopy
Worcester	Fitchburg	Burbank Hospital	Diagnostic and therapeutic nuclear medicine
Worcester	Gardner	Henry Heywood Memorial Hospital	Nuclear medicine
Worcester	Leominster	Leominster Hospital	Diagnostic nuclear medicine
Worcester	Milford	Biomeasure, Inc.	Life sciences research
Worcester	Milford	Milford-Whitinsville Regional Hospital	Diagnostic nuclear medicine
Worcester	Milford	TSI Center for Diagnostic Products	Diagnostic testing
Worcester	Shrewsbury	Biohybrid Technologies	Radioimmunoassay
Worcester	Shrewsbury	Digital Equipment Corp.	Air ionizing guns
Worcester	Shrewsbury	Sequegen	DNA sequencing
Worcester	Shrewsbury	Worcester Foundation for Experimental Biology	Biomedical R&D, teaching
Worcester	Southbridge	Harrington Memorial Hospital	Diagnostic nuclear medicine
Worcester	Worcester	Cambridge Biotech Corp.	Biotech research
Worcester	Worcester	Clark University	Biological research and training
Worcester	Worcester	College of the Holy Cross	Research and undergraduate teaching
Worcester	Worcester	Genica Pharmaceuticals Co.	DNA analysis, radioimmunoassay

Table A-1
Inventory of Organizations That Produced Radioactive Waste During 1993
(continued)

County[1]	City	Organization	Reason for use of Radioactive Materials
Worcester	Worcester	Hybridon	Biomedical R&D
Worcester	Worcester	Institute of Molecular Biology	Biotechnology R&D
Worcester	Worcester	Medical Center of Central MA (Hahnemann)	Diagnostic imaging and treatment of hyperthyroidism
Worcester	Worcester	Medical Center of Central MA (Memorial)	Diagnosis of medical problems in humans
Worcester	Worcester	St Vincent Hospital	Diagnostic and therapeutic nuclear medicine
Worcester	Worcester	Telesector Resources Group	Replacement of cathode electron tubes with digital switches
Worcester	Worcester	TSI Mason Laboratories	RIA procedures, tissue distribution studies, in-vitro immunotoxicity testing
Worcester	Worcester	University of Massachusetts Medical Center	Patient diagnosis and treatment, biomedical research
Worcester	Worcester	Worcester Polytechnic Institute	Education and research

[1] For organizations that produce waste at several locations, listed city is primary business address. Multiple listed organizations are separate units of the same company.

Table A-2
1993 Radioactive Waste Producer Volume and Activity Management Summary

Organization	Volume Produced (cuft)	On-Site[1] Volume Reduction (cuft)	Decay in Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off-Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste In Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Addison Gilbert Hospital	31.0	0.0	30.0	10.2	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Advacare Management Services	86.3	0.0	86.3	0.4	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Advanced Magnetics, Inc.	214.6	0.0	44.1	0.1	0.0	0.0	135.0	0.0	35.5	0.003	135.0	0.0
Alkermes Incorporated	395.7	180.0	15.2	0.0	135.5	0.0	5.0	42.8	17.2	0.023	0.0	0.0
American Red Cross Blood Services	163.5	0.0	0.0	0.0	3.0	0.0	160.5	0.0	0.0	0.000	0.5	0.0
Amersham Corporation	840.0	390.0	0.0	0.0	0.0	0.0	322.5	0.0	127.5	0.635	277.5	10,023.8
Amherst College	41.0	0.0	34.0	0.0	0.0	0.0	7.0	0.0	0.0	0.000	7.0	0.2
Amicon, Inc.	21.5	0.0	21.5	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Angell Memorial Animal Hospital	80.0	0.0	80.0	1.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Anna Jaques Hospital	10.0	0.0	10.0	0.8	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Applied bioTechnology, Inc.	4.3	0.0	3.3	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Arcturus Pharmaceutical Corp.	23.8	0.0	0.0	0.0	5.3	0.0	18.5	0.0	0.0	0.000	18.4	0.0
Ares Advanced Technology, Inc.	120.0	0.0	120.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Ariad Pharmaceuticals, Inc.	13.6	0.0	0.0	0.0	0.0	0.0	13.6	0.0	0.0	0.000	15.0	0.1
Army, Department of	27.1	0.0	17.8	0.0	0.0	0.0	9.4	0.0	0.0	0.000	40.3	0.1
Army, Department of (Watertown)	57,095.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57,095.0	0.434	0.0	0.0
Arthur D. Little, Inc.	40.0	34.7	0.0	0.0	0.4	0.0	5.0	0.0	0.0	0.000	0.0	0.0
AT & T Network Systems	2,600.1	0.0	0.0	0.0	0.0	0.0	2,600.1	0.0	0.0	0.000	0.0	0.0
AtlantiCare Medical Center	100.0	0.0	100.0	114.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Autoimmune, Inc.	10.9	9.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.000	1.0	0.0
Bartlett Nuclear, Inc.	2,500.0	2,450.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.000	50.0	0.1
BASF Bioresearch Corp.	142.5	0.0	0.0	0.0	30.0	0.0	7.5	0.0	105.0	0.162	0.0	0.0
Battelle Memorial Institute	43.8	0.0	0.0	0.0	0.0	0.0	43.8	0.0	0.0	0.000	45.8	0.0
Baystate Medical Center	102.0	0.0	50.0	0.0	0.0	0.0	52.0	0.0	0.0	0.000	0.0	0.0
Behring Diagnostics	8.8	0.0	1.3	0.0	0.0	0.0	0.0	0.0	7.5	0.001	0.0	0.0

Table A–2
1993 Radioactive Waste Producer Volume and Activity Management Summary
(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay in Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste in Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Berkshire Medical Center	500.0	0.0	500.0	0.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Beth Israel Hospital	1,324.2	0.0	1,118.4	1.0	176.4	0.0	0.0	22.1	7.4	0.009	0.0	0.0
Beverly Hospital	64.7	0.0	12.0	3.4	0.0	0.0	52.7	0.0	0.0	0.000	0.0	0.0
Biogen, Inc.	217.8	0.0	202.5	0.2	0.0	0.0	15.1	0.0	0.0	0.000	15.0	0.1
Biohybrid Technologies	110.0	0.0	100.0	0.0	0.0	0.0	10.0	0.0	0.0	0.000	0.0	0.0
Biomeasure, Inc.	102.7	0.0	61.1	0.0	30.0	0.0	0.0	5.0	8.8	0.003	0.0	0.0
Biomedical Technologies, Inc.	27.7	0.0	25.7	0.2	0.0	0.0	2.0	0.0	0.0	0.000	0.0	0.0
Bioran Medical Laboratory	0.9	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.000	0.0	0.0
BioSurface Technology, Inc.	47.8	21.0	3.8	0.0	0.0	0.0	9.0	0.0	14.0	0.002	7.0	0.0
Biotechnology Mgmt. Ass., Inc.	5.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Boston Biomedical Research Inst.	4.9	0.0	1.8	0.1	0.8	0.0	1.0	0.0	1.5	0.000	1.0	0.0
Boston City Hospital	225.7	0.0	75.0	0.1	19.1	0.0	0.0	0.0	131.6	0.003	0.0	0.0
Boston College	59.0	0.0	0.0	0.0	8.2	0.0	30.3	0.0	20.5	0.005	60.3	0.3
Boston Edison Co.	58,851.8	0.0	0.0	0.0	0.0	0.0	0.0	52,777.4	6,074.2	575.097	445.7	0.0
Boston Fertility Lab, Inc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Boston Heart Foundation	10.7	0.0	10.0	0.0	0.0	0.0	0.7	0.0	0.0	0.000	0.0	0.0
Boston University	159.5	0.0	120.0	0.0	15.0	0.0	24.5	0.0	0.0	0.000	22.5	0.0
Boston University Medical Ctr.	870.2	45.0	647.0	0.4	8.2	0.0	147.5	0.0	22.5	0.008	127.5	0.0
Brandeis University	300.0	90.0	105.0	0.8	82.5	0.0	0.0	15.0	7.5	0.494	0.0	0.0
Bridgewater State College	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	1.0	0.0
Brigham & Women's Hospital	2,450.3	0.0	1,976.4	4.8	466.4	0.2	7.5	0.0	0.0	0.000	0.0	0.0
Brockton Hospital	100.0	0.0	100.0	122.6	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Bunker Hill Community College	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Burbank Hospital	43.5	0.0	17.5	4.0	0.0	0.0	26.0	0.0	0.0	0.000	0.0	0.0
Cambridge Biotech Corp.	45.0	0.0	30.0	0.1	7.5	0.0	0.0	0.0	7.5	0.001	0.0	0.0

Table A–2
1993 Radioactive Waste Producer Volume and Activity Management Summary
(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay in Storage[2] Volume (cuft)	Decay in Storage[2] Activity (curies)	Incineration[2] Volume (cuft)	Incineration[2] Activity (curies)	Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal Volume (cuft)	Shipped for Disposal Activity (curies)	Total Accumulated Waste in Storage[4] Volume (cuft)	Total Accumulated Waste in Storage[4] Activity (curies)
Cambridge Hospital	7.5	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Cambridge Neuroscience Research	367.3	0.0	22.5	0.0	120.0	0.0	1.3	134.6	88.9	0.221	0.0	0.0
Cameo Diagnostic Center, Inc.	7.7	0.0	7.5	0.4	0.0	0.0	0.2	0.0	0.0	0.000	0.0	0.0
Cape Cod Hospital	150.0	0.0	100.0	0.9	0.0	0.0	50.0	0.0	0.0	0.000	0.0	0.0
Cardinal Cushing General Hospital	10.7	0.0	7.0	36.8	0.0	0.0	3.7	0.0	0.0	0.000	0.0	0.0
Carney Hospital	10.0	0.0	10.0	0.3	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Cellcor, Inc.	42.4	0.0	0.0	0.0	0.7	0.0	19.2	0.0	22.5	0.000	0.0	0.0
Center for Blood Research	306.5	0.0	259.5	0.2	7.5	0.0	39.5	0.0	0.0	0.000	2.5	0.0
Charles Stark Draper Lab, Inc.	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Charlton Memorial Hospital	100.0	0.0	100.0	213.7	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Charm Sciences, Inc.	870.0	0.0	0.0	0.0	0.0	0.0	870.0	0.0	0.0	0.000	0.5	0.0
Children's Hospital	1,759.0	0.0	1,365.0	1.6	382.0	0.1	5.0	0.0	7.0	0.000	0.0	0.0
Chiotellis, Phillip	10.0	0.0	10.0	3.4	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Ciba Corning Diagnostics Corp.	2,902.9	1,357.5	1,533.1	1.8	12.3	0.0	0.0	0.0	0.0	0.000	1,857.0	0.1
CIS–US, Inc.	66.0	16.1	9.6	0.2	0.0	0.0	7.5	0.0	32.8	0.174	7.5	0.2
Clark University	15.0	0.0	7.5	0.0	0.0	0.0	7.5	0.0	0.0	0.000	0.0	0.0
Clean Harbors Env. Services, Inc.	4.1	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.000	4.1	0.0
Clinical Science Laboratory, Inc.	150.0	0.0	150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Collaborative Biomedical Prods., Inc.	35.1	7.1	3.8	0.0	7.1	0.0	17.1	0.0	0.0	0.000	7.1	0.0
Collaborative Research, Inc.	917.5	0.0	217.5	0.5	0.0	0.0	700.0	0.0	0.0	0.000	0.0	0.0
College of the Holy Cross	6.4	0.0	3.1	0.0	0.0	0.0	3.3	0.0	0.0	0.000	0.0	0.0
Cooley Dickinson Hospital	10.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Creative Biomolecules, Inc.	94.5	0.0	72.0	0.0	0.0	0.0	22.5	0.0	0.0	0.000	22.5	0.0
CytoMed, Inc.	62.1	0.0	7.5	0.0	22.5	0.0	9.6	6.5	16.0	0.001	15.0	0.0
Damon Clinical Laboratories, Inc.	845.0	0.0	845.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0

Table A–2
1993 Radioactive Waste Producer Volume and Activity Management Summary
(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay in Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste in Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Dana–Farber Cancer Institute	2,406.3	0.0	1,752.5	7.1	653.8	0.4	0.0	0.0	0.0	0.000	0.0	0.0
Deaconess–Nashoba Hospital	7.5	0.0	7.5	78.6	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Diacrin, Inc.	92.0	67.5	2.0	0.0	0.0	0.0	0.0	0.0	22.5	0.019	0.0	0.0
Diagnostic Mgmt. Services, Inc.	22.5	0.0	22.5	8.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Digital Equipment Corp.	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Digital Equipment Corp. (Hudson)	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Digital Equipment Corp. (Marlboro)	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.000	0.0	0.0
Digital Scintigraphics	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Du Pont Medical Products	18,300.0	2,550.0	1,117.5	453.6	0.0	0.0	2,072.0	10,596.5	1,964.0	20,082.370	6,572.0	7,361.5
Du Pont Merck Pharmaceutical Co.	12,495.4	878.0	7,417.5	31.3	0.0	0.0	1,048.0	2,678.8	473.1	8.324	1,048.0	3.9
EG&G, Inc.	4.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	1.4	0.043	0.0	0.0
Eisai Research Institute	102.5	0.0	30.0	0.0	15.0	0.0	50.0	0.0	7.5	0.020	0.0	0.0
Emerson Hospital	18.0	0.0	18.0	5.9	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Environmental Protection Agency	2.2	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.000	0.0	0.0
Enzyme Center	1,028.0	0.0	28.0	0.0	0.0	0.0	1,000.0	0.0	0.0	0.000	0.0	0.0
Eunice Kennedy Shriver Center	15.5	0.0	12.4	0.0	3.1	0.0	0.0	0.0	0.0	0.000	0.0	0.0
E. I. Du Pont De Nemours & Co. [5]	886.5	551.0	0.0	0.0	0.0	0.0	0.0	0.0	335.5	41.350	0.0	0.0
E. I. Du Pont De Nemours & Co.	2,123.1	255.0	1,065.0	49.9	0.0	0.0	248.0	507.2	47.9	3.009	248.0	29.7
Factory Mutual Research Corp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Fairview Hospital	10.0	0.0	10.0	6.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Falmouth Hospital	100.0	0.0	100.0	201.9	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Faulkner Hospital	17.5	0.0	7.5	6.2	0.0	0.0	10.0	0.0	0.0	0.000	0.0	0.0
Fitchburg State College	9.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	1.0	0.0
Forsyth Dental Center	32.0	0.0	12.0	0.0	0.0	0.0	20.0	0.0	0.0	0.000	36.0	0.0
Franklin Medical Center	15.5	0.0	15.0	1.5	0.0	0.0	0.5	0.0	0.0	0.000	0.0	0.0

Table A-2
1993 Radioactive Waste Producer Volume and Activity Management Summary
(continued)

Organization	Volume Produced (cuft)	On-Site[1] Volume Reduction (cuft)	Decay In Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off-Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste In Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Fuji Immunopharmaceuticals Corp.	63.0	0.0	20.0	0.0	0.0	0.0	43.0	0.0	0.0	0.000	3.0	0.0
Genesis Pharmaceuticals, Inc	20.8	0.0	0.0	0.0	8.2	0.0	0.0	8.4	4.2	0.001	0.0	0.0
Genetics Institute	817.6	495.0	14.1	0.4	45.0	0.0	16.0	96.7	150.8	0.648	2.9	0.0
Gene-Trak Systems	421.0	0.0	200.0	0.2	210.0	0.0	10.0	0.0	1.0	0.001	0.0	0.0
Genica Pharmaceuticals Co.	14.1	0.0	0.0	0.0	7.5	0.0	0.0	0.0	6.6	0.001	0.0	0.0
GENTEST Corporation	6.5	0.0	0.0	0.0	4.5	0.0	2.0	0.0	0.0	0.000	0.0	0.0
Genzyme Corp.	819.0	0.0	421.5	0.2	0.0	0.0	397.5	0.0	0.0	0.000	52.5	0.2
Glover Memorial Hospital	2.0	0.0	2.0	76.8	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Hale Hospital	24.0	0.0	16.0	1.1	0.0	0.0	8.0	0.0	0.0	0.000	0.0	0.0
Harrington Memorial Hospital	2.7	0.0	2.7	0.3	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Harvard University	3,923.7	801.9	2,393.6	3.8	520.9	0.3	200.0	0.0	7.3	0.001	0.0	0.0
Health & Human Services, Dept. of	33.4	0.0	19.1	0.0	0.0	0.0	2.7	0.0	11.6	0.182	0.0	0.0
Hemagen Diagnostics, Inc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Henry Heywood Memorial Hospital	7.5	0.0	7.5	50.8	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Hillcrest Hospital	5.1	0.0	5.1	59.6	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Holy Family Hospital and Med. Ctr.	70.5	0.0	70.5	0.8	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Holyoke Hospital	92.0	0.0	40.0	0.0	0.0	0.0	52.0	0.0	0.0	0.000	0.0	0.0
Hybridon	65.5	0.0	61.4	0.2	0.0	0.0	4.1	0.0	0.0	0.000	11.6	0.0
Imaging Associates, Inc.	2.0	0.0	2.0	0.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
IMI, Inc.	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
ImmuLogic Pharmaceutical Corp.	533.0	0.0	30.0	0.0	12.0	0.0	416.0	0.0	75.0	0.245	0.0	0.0
ImmunoGen, Inc.	461.0	0.0	0.0	0.0	4.0	0.0	457.0	0.0	0.0	0.000	27.0	0.0
INS Corporation	654,666.4	22.5	0.0	0.0	0.0	0.0	652,904.3	1,329.3	410.3	1.805	204.4	0.7
Institute of Molecular Biology	228.7	0.0	37.5	0.0	142.5	0.0	3.7	30.0	15.0	0.007	0.0	0.0
Interior, Department of the	7.1	0.0	2.0	0.0	0.0	0.0	5.1	0.0	0.0	0.000	3.0	0.0

Table A–2

1993 Radioactive Waste Producer Volume and Activity Management Summary

(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay in Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste in Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Interneuron Pharmaceuticals, Inc.	7.0	0.0	3.0	0.0	0.0	0.0	4.0	0.0	0.0	0.000	4.0	0.0
Jordan Hospital	64.0	0.0	12.0	1.3	0.0	0.0	52.0	0.0	0.0	0.000	0.0	0.0
Joslin Diabetes Center	507.5	0.0	404.1	0.7	103.4	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Kidde–Fenwal, Inc.	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.000	0.7	0.7
Lahey Clinic Medical Center	71.0	0.0	70.0	1.7	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Lawrence General Hospital	20.0	0.0	20.0	46.3	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Lawrence Mem. Hospital of Medford	6.0	0.0	6.0	0.6	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Leominster Hospital	17.5	0.0	17.5	62.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
LFE Industrial Systems Corp.	8.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.000	8.0	62.0
Lowell General Hospital	3.0	0.0	3.0	0.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Lowell, University of Massachusetts	40.0	7.0	23.0	0.0	1.0	0.0	9.0	0.0	0.0	0.000	7.0	0.0
Ludlow Hospital	10.0	0.0	5.0	0.0	0.0	0.0	5.0	0.0	0.0	0.000	0.0	0.0
Malden Hospital	3.0	0.0	3.0	1.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Mallinckrodt Medical, Inc.	931.0	0.0	540.0	0.0	0.0	0.0	364.0	0.0	27.0	0.004	4.0	0.0
Marine Biological Laboratory	124.8	45.0	12.3	0.1	22.5	0.0	0.0	7.5	37.5	0.087	0.0	0.0
Marlborough Hospital	10.7	0.0	10.0	0.6	0.0	0.0	0.7	0.0	0.0	0.000	0.0	0.0
Martha's Vineyard Hospital	52.0	0.0	0.0	0.0	0.0	0.0	52.0	0.0	0.0	0.000	0.0	0.0
Massachusetts College of Pharmacy	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Massachusetts Eye & Ear Infirmary	228.6	0.0	207.7	0.1	0.9	0.0	20.0	0.0	0.0	0.000	0.0	0.0
Massachusetts General Hospital	4,361.9	0.0	3,528.1	5.6	633.8	0.1	200.0	0.0	0.0	0.000	0.0	0.0
Mass. Institute of Technology	1,907.6	510.0	570.0	1.0	259.1	0.0	441.0	55.5	72.0	0.908	0.0	0.0
Massachusetts, University of	476.3	127.5	315.0	0.2	0.0	0.0	33.8	0.0	0.0	0.000	63.8	0.2
Massachusetts, U. of (Dartmouth)	4.3	0.0	4.0	0.0	0.0	0.0	0.3	0.0	0.0	0.000	0.0	0.0
Massachusetts, U. of (Boston)	75.0	15.0	30.0	1.0	15.0	0.7	0.0	0.0	15.0	4.427	0.0	0.0
Matritech, Inc.	37.0	0.0	36.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0

Table A–2

1993 Radioactive Waste Producer Volume and Activity Management Summary

(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay in Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste in Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Med. Ctr. of Central MA	64.0	0.0	12.0	10.0	0.0	0.0	52.0	0.0	0.0	0.000	0.0	0.0
Med. Ctr. of Central MA (Memorial)	2.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Mediq Imaging Services, Inc.	179.0	0.0	179.0	7.8	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Melrose\Wakefield Hospital	100.0	0.0	100.0	140.9	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Mercy Hospital	10.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Metasyn, Inc.	71.0	28.4	0.0	0.0	0.0	0.0	16.2	0.0	26.4	0.002	14.2	0.0
Metpath, Inc.	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.000	0.0	0.0
Metrowest Medical Center	36.1	0.0	36.1	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Milford–Whitinsville Reg. Hospital	7.5	0.0	7.5	55.5	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Millipore Corporation	72.5	11.7	26.6	0.0	22.5	0.0	4.2	4.6	2.9	0.010	8.1	0.0
Milton Hospital	10.8	0.0	10.8	66.4	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Morton Hospital and Medical Center	20.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Mount Holyoke College	20.0	0.0	15.0	0.0	0.0	0.0	5.0	0.0	0.0	0.000	5.0	0.0
Mt. Auburn Hospital	66.9	0.0	38.8	4.8	0.0	0.0	28.1	0.0	0.0	0.000	118.3	0.0
MYCO Pharmaceuticals, Inc.	22.0	0.0	0.0	0.0	0.0	0.0	22.0	0.0	0.0	0.000	20.5	0.0
M/A–COM, Inc.	292.1	0.0	0.0	0.0	0.0	0.0	96.0	0.0	196.1	49.737	96.0	0.0
New England Aquarium	17.8	0.0	0.0	0.0	8.2	0.0	0.7	0.0	8.9	0.021	0.0	0.0
New England Baptist Hospital	79.0	0.0	78.0	5.8	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
New England Biolabs, Inc.	75.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	0.000	95.0	0.1
New England Deaconess Hospital	490.2	0.0	277.5	0.1	52.5	0.0	7.5	67.5	85.2	1.267	7.5	0.0
New England Medical Center	946.6	315.0	420.5	143.2	22.5	0.0	31.1	78.0	79.5	0.145	26.3	0.0
New England Memorial Hospital	7.5	0.0	7.5	62.7	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
New England Pathology Services	170.0	0.0	160.0	0.0	0.0	0.0	10.0	0.0	0.0	0.000	0.0	0.0
Newton–Wellesley Hospital	7.5	0.0	7.5	106.4	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Nissin Molecular Biology Inst., Inc.	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0

Table A–2

1993 Radioactive Waste Producer Volume and Activity Management Summary

(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay In Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste In Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Noble Hospital	10.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
North Adams Regional Hospital	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Northeastern University	172.3	48.1	50.0	0.1	52.1	0.0	6.0	0.0	16.0	0.006	0.0	0.0
Norwood Hospital	28.0	0.0	28.0	33.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Nuclear Metals, Inc.	10,997.9	3,136.9	0.0	0.0	67.5	0.0	944.0	4,358.3	2,491.2	4.462	0.0	0.0
Optical Corporation of America	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.000	0.7	0.0
Oravax, Inc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Organogenesis, Inc.	43.5	0.0	6.0	0.0	0.0	0.0	0.0	17.7	19.8	0.012	0.0	0.0
Osram Sylvania, Inc.	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.000	2.0	0.0
Osteo Arthritis Sciences	50.0	0.0	0.0	0.0	22.5	0.0	5.0	0.0	22.5	0.001	0.0	0.0
Our Lady of the Elms College	4.0	0.0	3.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Oxford Analytical, Inc.	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.000	0.5	1.3
Panametrics, Inc.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	1.0	0.0
PharmaMar USA, Inc.	60.0	45.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.000	15.0	0.0
Polaroid Corporation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	2.0	2.0
Procept, Inc.	52.5	0.0	37.5	0.0	0.0	0.0	15.0	0.0	0.0	0.000	15.0	0.0
Protein Engineering Corp.	10.9	0.0	6.8	0.0	0.0	0.0	0.1	2.0	2.0	0.011	0.0	0.0
Providence Hospital	10.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Quincy City Hospital	8.0	0.0	8.0	10.7	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Raytheon Company	859.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	859.0	0.000	0.0	0.0
Raytheon Company (Sudbury)	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.000	3.0	0.1
Repligen Corporation	157.5	45.0	67.5	0.2	15.0	0.0	22.5	0.0	7.5	0.023	22.5	0.0
Repligen Sandoz Research Corp.	9.5	0.0	4.5	0.0	0.0	0.0	5.0	0.0	0.0	0.000	5.0	0.0
RTS Technology, Inc.	22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	0.130	0.0	0.0
Salem Hospital	15.0	0.0	15.0	12.7	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0

Table A-2
1993 Radioactive Waste Producer Volume and Activity Management Summary
(continued)

Organization	Volume Produced (cuft)	On-Site[1] Volume Reduction (cuft)	Decay In Storage[2] Volume (cuft)	Decay In Storage[2] Activity (curies)	Incineration[2] Volume (cuft)	Incineration[2] Activity (curies)	Other[3] Methods Volume (cuft)	Off-Site Volume Reduction (cuft)	Shipped for Disposal Volume (cuft)	Shipped for Disposal Activity (curies)	Total Accumulated Waste in Storage[4] Volume (cuft)	Total Accumulated Waste in Storage[4] Activity (curies)
Salem & Beverly Water Supply Bd.	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.000	0.0	0.0
Schepens Eye Research Institute	40.7	0.0	31.1	0.0	9.6	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Sequegen	7.5	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Seragen, Inc.	1,264.1	832.5	15.0	0.0	11.6	0.0	0.0	85.0	320.0	0.091	0.0	0.0
Serono Laboratories, Inc.	41.0	0.0	41.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Simmons College	35.7	0.0	0.7	0.0	15.0	0.0	0.0	12.7	7.3	3.928	0.0	0.0
Skinner & Sherman Laboratories	4.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.000	0.0	0.0
Smith College	14.3	0.0	13.3	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
SmithKline Beecham Clinical Lab.	227.8	195.0	0.0	0.0	0.0	0.0	17.8	0.0	15.0	0.100	15.0	0.1
Somerville Hospital	7.5	0.0	7.5	7.9	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
South Shore Hospital	9.7	0.0	9.0	0.6	0.0	0.0	0.7	0.0	0.0	0.000	0.0	0.0
Southwood Community Hospital	27.7	0.0	27.0	14.3	0.0	0.0	0.0	0.0	0.7	0.010	0.0	0.0
Spaulding Rehabilitation Hospital	5.0	0.0	4.0	0.3	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Sprague Co.	15,849.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15,849.0	0.050	0.0	0.0
Springborn Laboratories, Inc.	397.5	97.5	0.0	0.0	202.5	0.0	0.0	0.0	97.5	0.026	0.0	0.0
St Anne's Hospital	5,200.0	0.0	5,200.0	87.3	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
St Elizabeth's Hospital	10.1	0.0	10.0	0.1	0.0	0.0	0.1	0.0	0.0	0.000	0.0	0.0
St Joseph's Hospital	250.1	0.0	250.0	252.4	0.0	0.0	0.1	0.0	0.0	0.000	0.0	0.0
St Luke's Hospital	125.0	0.0	125.0	199.6	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
St Vincent Hospital	147.0	0.0	147.0	46.9	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Strichman Medical Equipment	1.5	0.0	1.5	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Sturdy Memorial Hospital	7.5	0.0	7.5	112.6	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Symmes Hospital	10.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Syncor International Corporation	230.0	0.0	230.0	3.5	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
T Cell Sciences, Inc.	6,548.8	0.0	7.5	0.0	7.5	0.0	6,503.8	0.0	30.0	0.023	26.6	0.0

Table A–2
1993 Radioactive Waste Producer Volume and Activity Management Summary
(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay in Storage[2] Volume (cuft)	Decay in Storage[2] Activity (curies)	Incineration[2] Volume (cuft)	Incineration[2] Activity (curies)	Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal Volume (cuft)	Shipped for Disposal Activity (curies)	Total Accumulated Waste in Storage[4] Volume (cuft)	Total Accumulated Waste in Storage[4] Activity (curies)
Telesector Resources Group	61.1	0.0	0.0	0.0	0.0	0.0	58.3	0.0	2.8	0.000	0.0	0.0
Texas Instruments	8,288.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8,288.0	0.059	0.0	0.0
Textron Defense Systems	34.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.1	1.446	0.0	0.0
Therion Biologics Corporation	4.1	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Thermo Environmental Instruments	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	7.680	0.0	0.0
Tilcon Capaldi Inc.	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Tobey Hospital	100.0	0.0	100.0	45.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Toxikon Corporation	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	0.0	0.0
Transkaryotic Therapies, Inc.	94.5	0.0	45.0	0.0	0.0	0.0	12.0	0.0	37.5	0.001	0.0	0.0
TSI Center for Diagnostic Products	71.6	0.0	35.4	0.0	0.0	0.0	36.2	0.0	0.0	0.000	0.0	0.0
TSI Mason Laboratories	110.7	0.0	94.3	0.0	0.0	0.0	16.4	0.0	0.0	0.000	24.6	0.0
Tufts University	92.5	0.0	52.5	0.0	0.0	0.0	10.0	0.0	30.0	0.003	0.0	0.0
Tufts University School of Medicine	900.0	420.0	247.5	0.2	22.5	0.0	0.0	109.0	101.0	0.536	0.0	0.0
U. of Massachusetts Medical Center	2,949.0	0.0	2,690.0	15.4	30.0	1.0	229.0	0.0	0.0	0.000	0.0	0.0
USDA Human Nutrition Res. Ctr.	194.0	105.0	15.0	0.0	21.5	0.0	0.0	31.9	20.6	0.003	0.0	0.0
V A Medical Center, Boston	298.7	7.5	233.0	71.1	30.0	0.0	20.0	0.0	8.2	0.006	0.0	0.0
V A Hospital (ENRM)	50.0	0.0	0.0	0.0	22.5	2.2	20.0	0.0	7.5	1.606	15.0	1.2
Varian Associates	45.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.7	31.078	0.0	0.0
Vazorx, Inc.	30.0	0.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Vertex Pharmaceuticals	75.7	0.0	15.0	0.0	15.7	0.0	0.0	0.0	45.0	0.027	0.0	0.0
Vicam	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	4.0	0.0
Virus Research Institute	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Waltham/Weston Hospital	8.7	0.0	8.0	10.3	0.0	0.0	0.7	0.0	0.0	0.000	0.0	0.0
Wellesley College	30.5	0.0	20.0	0.0	0.0	0.0	10.5	0.0	0.0	0.000	10.5	0.0
Wheaton College	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	4.0	0.0

Table A–2

1993 Radioactive Waste Producer Volume and Activity Management Summary

(continued)

Organization	Volume Produced (cuft)	On–Site[1] Volume Reduction (cuft)	Decay in Storage[2]		Incineration[2]		Other[3] Methods Volume (cuft)	Off–Site Volume Reduction (cuft)	Shipped for Disposal		Total Accumulated Waste in Storage[4]	
			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)			Volume (cuft)	Activity (curies)	Volume (cuft)	Activity (curies)
Whidden Memorial Hospital	32.7	0.0	32.0	10.3	0.0	0.0	0.7	0.0	0.0	0.000	0.0	0.0
Whitehead Inst. for Biomedical Res.	529.1	0.0	278.0	1.0	24.1	0.0	227.0	0.0	0.0	0.000	0.0	0.0
Williams College	4.0	0.0	3.0	0.0	0.0	0.0	1.0	0.0	0.0	0.000	4.0	0.0
Winchester Hospital	7.5	0.0	7.5	128.4	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Wing Memorial Hospital	10.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Winthrop Hospital	6.0	0.0	6.0	0.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
Woods Hole Oceanographic Institute	142.8	0.0	114.1	0.1	16.4	0.0	0.0	0.0	12.3	0.000	0.0	0.0
Worcester Foundation for Exp. Bio.	685.1	0.0	625.0	3.7	30.0	0.2	0.1	0.0	30.0	1.350	0.0	0.0
Worcester Polytechnic Institute	4.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0
W.R. Grace & Co.	37.0	0.0	35.0	0.0	0.0	0.0	2.0	0.0	0.0	0.000	0.0	0.0
Yankee Atomic Electric Co.	38,461.0	1,020.0	0.0	0.0	0.0	0.0	0.0	26,818.0	10,623.0	17,245.410	0.0	0.0
Total	947,043.1	17,242.4	43,762.4	3,364.607	4,924.3	5.321	674,233.6	99,900.6	106,979.8	38,069.988	12,042.8	17,488.902

[1] On–site treatment values are for all waste produced (including waste placed in storage).

[2] Decay in storage and incineration values are on and off–site totals.

[3] "Other" methods include: atmospheric release, sewerage release, and transfer to an authorized recipient.

[4] Waste in storage includes LLRW placed in storage during and before 1993, and does not include storage for decay.

[5] Waste produced prior to 1991.

Note: values <0.1 appear as zero.

Table A-3
Ranking by Volume of Organizations that Shipped LLRW for Disposal During 1993

Organization	Volume (cuft)					
	Class A\AH	Class B	Class C	Total	% of Total	Cumulative %
Army, Department of (Watertown)	57,095.0	0.0	0.0	57,095.0	53.4	53.4
Sprague Co.	15,849.0	0.0	0.0	15,849.0	14.8	68.2
Yankee Atomic Electric Co.	9,972.0	651.0	0.0	10,623.0	9.9	78.1
Texas Instruments	8,288.0	0.0	0.0	8,288.0	7.7	85.9
Boston Edison Co.	5,941.8	132.4	0.0	6,074.2	5.7	91.5
Nuclear Metals, Inc.	2,491.2	0.0	0.0	2,491.2	2.3	93.9
Du Pont Medical Products	1,934.0	30.0	0.0	1,964.0	1.8	95.7
Raytheon Company	859.0	0.0	0.0	859.0	0.8	96.5
Du Pont Merck Pharmaceutical Co.	473.1	0.0	0.0	473.1	0.4	96.9
INS Corporation	410.3	0.0	0.0	410.3	0.4	97.3
E. I. Du Pont De Nemours and Co. [1]	335.5	0.0	0.0	335.5	0.3	97.6
Seragen, Inc.	320.0	0.0	0.0	320.0	0.3	97.9
M/A-COM, Inc.	196.1	0.0	0.0	196.1	0.2	98.1
Genetics Institute	150.8	0.0	0.0	150.8	0.1	98.3
Boston City Hospital	131.6	0.0	0.0	131.6	0.1	98.4
Amersham Corporation	127.5	0.0	0.0	127.5	0.1	98.5
BASF Bioresearch Corp.	105.0	0.0	0.0	105.0	0.1	98.6
Tufts University School of Medicine	101.0	0.0	0.0	101.0	0.1	98.7
Springborn Laboratories, Inc.	97.5	0.0	0.0	97.5	0.1	98.8
Cambridge Neuroscience Research	88.9	0.0	0.0	88.9	0.1	98.9
New England Deaconess Hospital	85.2	0.0	0.0	85.2	0.1	99.0
New England Medical Center	79.5	0.0	0.0	79.5	0.1	99.0
ImmuLogic Pharmaceutical Corp.	75.0	0.0	0.0	75.0	0.1	99.1
Massachusetts Institute of Technology	72.0	0.0	0.0	72.0	0.1	99.2
E. I. Du Pont De Nemours & Co.	47.9	0.0	0.0	47.9	0.0	99.2
Varian Associates	45.7	0.0	0.0	45.7	0.0	99.3
Vertex Pharmaceuticals	45.0	0.0	0.0	45.0	0.0	99.3
Marine Biological Laboratory	37.5	0.0	0.0	37.5	0.0	99.3
Transkaryotic Therapies, Inc.	37.5	0.0	0.0	37.5	0.0	99.4
Advanced Magnetics, Inc.	35.5	0.0	0.0	35.5	0.0	99.4
Textron Defense Systems	34.1	0.0	0.0	34.1	0.0	99.4
CIS-US, Inc.	32.8	0.0	0.0	32.8	0.0	99.5
Tufts University	30.0	0.0	0.0	30.0	0.0	99.5
Worcester Foundation for Exp. Biology	22.5	7.5	0.0	30.0	0.0	99.5
T Cell Sciences, Inc.	30.0	0.0	0.0	30.0	0.0	99.5
Mallinckrodt Medical, Inc.	27.0	0.0	0.0	27.0	0.0	99.6
Metasyn, Inc.	26.4	0.0	0.0	26.4	0.0	99.6
Osteo Arthritis Sciences	22.5	0.0	0.0	22.5	0.0	99.6
Cellcor, Inc.	22.5	0.0	0.0	22.5	0.0	99.6
RTS Technology, Inc.	22.5	0.0	0.0	22.5	0.0	99.7
Diacrin, Inc.	22.5	0.0	0.0	22.5	0.0	99.7

Table A–3
Ranking by Volume of Organizations that Shipped LLRW for Disposal During 1993
(continued)

	Volume (cuft)					
Organization	Class A\AH	Class B	Class C	Total	% of Total	Cumulative %
Boston University Medical Center	22.5	0.0	0.0	22.5	0.0	99.7
USDA Human Nutrition Research Center	20.6	0.0	0.0	20.6	0.0	99.7
Boston College	20.5	0.0	0.0	20.5	0.0	99.7
Organogenesis, Inc.	19.8	0.0	0.0	19.8	0.0	99.8
Alkermes Incorporated	17.2	0.0	0.0	17.2	0.0	99.8
Northeastern University	16.0	0.0	0.0	16.0	0.0	99.8
CytoMed, Inc.	16.0	0.0	0.0	16.0	0.0	99.8
Institute of Molecular Biology	15.0	0.0	0.0	15.0	0.0	99.8
SmithKline Beecham Clinical Laboratory	15.0	0.0	0.0	15.0	0.0	99.8
Massachusetts, University of (Boston)	15.0	0.0	0.0	15.0	0.0	99.9
BioSurface Technology, Inc.	14.0	0.0	0.0	14.0	0.0	99.9
Woods Hole Oceanographic Institute	12.3	0.0	0.0	12.3	0.0	99.9
Health & Human Services, Department of	11.6	0.0	0.0	11.6	0.0	99.9
New England Aquarium	8.2	0.7	0.0	8.9	0.0	99.9
V A Medical Center, Boston	8.2	0.0	0.0	8.2	0.0	99.9
Behring Diagnostics	7.5	0.0	0.0	7.5	0.0	99.9
Repligen Corporation	7.5	0.0	0.0	7.5	0.0	99.9
Cambridge Biotech Corp.	7.5	0.0	0.0	7.5	0.0	99.9
V A Hospital (ENRM)	7.5	0.0	0.0	7.5	0.0	99.9
Eisai Research Institute	7.5	0.0	0.0	7.5	0.0	99.9
Brandeis University	7.5	0.0	0.0	7.5	0.0	99.9
Beth Israel Hospital	7.4	0.0	0.0	7.4	0.0	100.0
Harvard University	7.3	0.0	0.0	7.3	0.0	100.0
Simmons College	6.3	0.0	1.0	7.3	0.0	100.0
Children's Hospital	7.0	0.0	0.0	7.0	0.0	100.0
Biomeasure, Inc.	6.6	0.0	0.0	6.6	0.0	100.0
Genica Pharmaceuticals Co.	6.6	0.0	0.0	6.6	0.0	100.0
Genesis Pharmaceuticals, Inc	4.2	0.0	0.0	4.2	0.0	100.0
Millipore Corporation	2.9	0.0	0.0	2.9	0.0	100.0
Telesector Resources Group	2.8	0.0	0.0	2.8	0.0	100.0
Protein Engineering Corp.	2.0	0.0	0.0	2.0	0.0	100.0
Boston Biomedical Research Institute	1.5	0.0	0.0	1.5	0.0	100.0
EG&G, Inc.	1.4	0.0	0.0	1.4	0.0	100.0
Digital Equipment Corp. (Marlboro)	1.1	0.0	0.0	1.1	0.0	100.0
Gene–Trak Systems	1.0	0.0	0.0	1.0	0.0	100.0
Southwood Community Hospital	0.7	0.0	0.0	0.7	0.0	100.0
Thermo Environmental Instruments	0.0	0.7	0.0	0.7	0.0	100.0
Total	106,156.6	822.3	1.0	106,979.8	100.0	

[1] Waste generated prior to 1991.

Table A–4

Ranking by Activity of Organizations that Shipped LLRW for Disposal During 1993

	Activity (curies)					
Organization	Class A/AH	Class B	Class C	Total	% of Total	Cumulative %
Du Pont Medical Products	125.3100	19,957.0600	0.0000	20,082.3700	52.8	52.8
Yankee Atomic Electric Co.	1,289.9823	15,955.4280	0.0000	17,245.4103	45.3	98.1
Boston Edison Co.	92.7967	482.3003	0.0000	575.0971	1.5	99.6
M/A–COM, Inc.	49.7365	0.0000	0.0000	49.7365	0.1	99.7
E. I. Du Pont De Nemours and Co. [1]	41.3498	0.0000	0.0000	41.3498	0.1	99.8
Varian Associates	31.0782	0.0000	0.0000	31.0782	0.1	99.9
Du Pont Merck Pharmaceutical Co.	8.3244	0.0000	0.0000	8.3244	0.0	99.9
Thermo Environmental Instruments	0.0000	7.6798	0.0000	7.6798	0.0	99.9
Nuclear Metals, Inc.	4.4620	0.0000	0.0000	4.4620	0.0	99.9
Massachusetts, University of (Boston)	4.4270	0.0000	0.0000	4.4270	0.0	99.9
Simmons College	3.9275	0.0000	0.0001	3.9276	0.0	100.0
E. I. Du Pont De Nemours & Co.	3.0087	0.0000	0.0000	3.0087	0.0	100.0
INS Corporation	1.8054	0.0000	0.0000	1.8054	0.0	100.0
V A Hospital (ENRM)	1.6060	0.0000	0.0000	1.6060	0.0	100.0
Textron Defense Systems	1.4460	0.0000	0.0000	1.4460	0.0	100.0
Worcester Foundation for Exp. Biology	0.2200	1.1300	0.0000	1.3500	0.0	100.0
New England Deaconess Hospital	1.2669	0.0000	0.0000	1.2669	0.0	100.0
Massachusetts Institute of Technology	0.9080	0.0000	0.0000	0.9080	0.0	100.0
Genetics Institute	0.6479	0.0000	0.0000	0.6479	0.0	100.0
Amersham Corporation	0.6350	0.0000	0.0000	0.6350	0.0	100.0
Tufts University School of Medicine	0.5363	0.0000	0.0000	0.5363	0.0	100.0
Brandeis University	0.4940	0.0000	0.0000	0.4940	0.0	100.0
Army, Department of (Watertown)	0.4335	0.0000	0.0000	0.4335	0.0	100.0
ImmuLogic Pharmaceutical Corp.	0.2449	0.0000	0.0000	0.2449	0.0	100.0
Cambridge Neuroscience Research	0.2211	0.0000	0.0000	0.2211	0.0	100.0
Health & Human Services, Department of	0.1817	0.0000	0.0000	0.1817	0.0	100.0
CIS–US, Inc.	0.1741	0.0000	0.0000	0.1741	0.0	100.0
BASF Bioresearch Corp.	0.1624	0.0000	0.0000	0.1624	0.0	100.0
New England Medical Center	0.1453	0.0000	0.0000	0.1453	0.0	100.0
RTS Technology, Inc.	0.1300	0.0000	0.0000	0.1300	0.0	100.0
SmithKline Beecham Clinical Laboratory	0.1000	0.0000	0.0000	0.1000	0.0	100.0
Seragen, Inc.	0.0906	0.0000	0.0000	0.0906	0.0	100.0
Marine Biological Laboratory	0.0868	0.0000	0.0000	0.0868	0.0	100.0
Texas Instruments	0.0593	0.0000	0.0000	0.0593	0.0	100.0
Sprague Co.	0.0503	0.0000	0.0000	0.0503	0.0	100.0
EG&G, Inc.	0.0430	0.0000	0.0000	0.0430	0.0	100.0
Vertex Pharmaceuticals	0.0269	0.0000	0.0000	0.0269	0.0	100.0
Springborn Laboratories, Inc.	0.0264	0.0000	0.0000	0.0264	0.0	100.0
T Cell Sciences, Inc.	0.0228	0.0000	0.0000	0.0228	0.0	100.0
Repligen Corporation	0.0228	0.0000	0.0000	0.0228	0.0	100.0
Alkermes Incorporated	0.0227	0.0000	0.0000	0.0227	0.0	100.0

Table A–4
Ranking by Activity of Organizations that Shipped LLRW for Disposal During 1993
(continued)

	Activity (curies)					
Organization	Class A/AH	Class B	Class C	Total	% of Total	Cumulative %
New England Aquarium	0.0059	0.0150	0.0000	0.0209	0.0	100.0
Eisal Research Institute	0.0202	0.0000	0.0000	0.0202	0.0	100.0
Diacrin, Inc.	0.0191	0.0000	0.0000	0.0191	0.0	100.0
Organogenesis, Inc.	0.0124	0.0000	0.0000	0.0124	0.0	100.0
Protein Engineering Corp.	0.0110	0.0000	0.0000	0.0110	0.0	100.0
Southwood Community Hospital	0.0100	0.0000	0.0000	0.0100	0.0	100.0
Millipore Corporation	0.0095	0.0000	0.0000	0.0095	0.0	100.0
Beth Israel Hospital	0.0086	0.0000	0.0000	0.0086	0.0	100.0
Boston University Medical Ctr.	0.0080	0.0000	0.0000	0.0080	0.0	100.0
Institute of Molecular Biology	0.0074	0.0000	0.0000	0.0074	0.0	100.0
V A Medical Center, Boston	0.0062	0.0000	0.0000	0.0062	0.0	100.0
Northeastern University	0.0060	0.0000	0.0000	0.0060	0.0	100.0
Boston College	0.0053	0.0000	0.0000	0.0053	0.0	100.0
Mallinckrodt Medical, Inc.	0.0038	0.0000	0.0000	0.0038	0.0	100.0
Biomeasure, Inc.	0.0034	0.0000	0.0000	0.0034	0.0	100.0
Tufts University	0.0030	0.0000	0.0000	0.0030	0.0	100.0
Advanced Magnetics, Inc.	0.0030	0.0000	0.0000	0.0030	0.0	100.0
Boston City Hospital	0.0028	0.0000	0.0000	0.0028	0.0	100.0
USDA Human Nutrition Research Center	0.0027	0.0000	0.0000	0.0027	0.0	100.0
BioSurface Technology, Inc.	0.0022	0.0000	0.0000	0.0022	0.0	100.0
Metasyn, Inc.	0.0020	0.0000	0.0000	0.0020	0.0	100.0
Genica Pharmaceuticals Co.	0.0012	0.0000	0.0000	0.0012	0.0	100.0
Osteo Arthritis Sciences	0.0012	0.0000	0.0000	0.0012	0.0	100.0
Transkaryotic Therapies, Inc.	0.0012	0.0000	0.0000	0.0012	0.0	100.0
Behring Diagnostics	0.0010	0.0000	0.0000	0.0010	0.0	100.0
Genesis Pharmaceuticals, Inc	0.0010	0.0000	0.0000	0.0010	0.0	100.0
Gene–Trak Systems	0.0010	0.0000	0.0000	0.0010	0.0	100.0
CytoMed, Inc.	0.0010	0.0000	0.0000	0.0010	0.0	100.0
Harvard University	0.0007	0.0000	0.0000	0.0007	0.0	100.0
Cambridge Biotech Corp.	0.0005	0.0000	0.0000	0.0005	0.0	100.0
Raytheon Company	0.0003	0.0000	0.0000	0.0003	0.0	100.0
Telesector Resources Group	0.0002	0.0000	0.0000	0.0002	0.0	100.0
Cellcor, Inc.	0.0002	0.0000	0.0000	0.0002	0.0	100.0
Boston Biomedical Research Institute	0.0002	0.0000	0.0000	0.0002	0.0	100.0
Woods Hole Oceanographic Institute	0.0001	0.0000	0.0000	0.0001	0.0	100.0
Children's Hospital	0.0000	0.0000	0.0000	0.0000	0.0	100.0
Digital Equipment Corp. (Marlboro)	0.0000	0.0000	0.0000	0.0000	0.0	100.0
Total	1,666.3752	36,403.6132	0.0001	38,069.9885	100.0	

[1] Waste generated prior to 1991.

Table A–5
1993 LLRW Volume and Activity Shipped for Disposal – by County

County	Volume (cubic feet)	% of Total	Activity (curies)	% of Total
Barnstable	49.8	0.0	0.0869	0.0
Berkshire	15,849.0	14.5	0.0503	0.0
Bristol	8,315.0	7.6	0.0631	0.0
Dukes	0.0	0.0	0.0000	0.0
Essex	77.1	0.1	31.2714	0.1
Franklin	10,623.0	9.7	17,245.4103	45.3
Hampden	410.3	0.4	1.8054	0.0
Hampshire	0.0	0.0	0.0000	0.0
Middlesex	62,830.8	57.6	114.3554	0.3
Nantucket	0.0	0.0	0.0000	0.0
Norfolk	28.7	0.0	7.7032	0.0
Plymouth	6,171.7	5.7	575.1235	1.5
Suffolk	2,556.0	2.3	20,092.7565	52.8
Worcester	68.5	0.1	1.3627	0.0
Total	106,979.8	100.0	38,069.9885	100.0

Appendix B: Radioactivity Information

Table B-1
Inventory of Radionuclides with Half-Lives of 90 Days or Less Contained in 1993 LLRW Shipped for Disposal – by Generator Category
(curies)

Radionuclide	Half-Life (days)	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
Miscellaneous	< 3 Hour	0.000000	0.021300	0.000000	0.000000	0.000000	0.021300
Tc-99M	0.3	0.193000	0.000000	0.000000	0.000000	0.000000	0.193000
Pb-201	0.4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
I-123	0.6	0.000012	0.000833	0.000000	0.000480	0.000000	0.001325
La-140	1.7	0.000000	0.000000	0.000000	0.000000	0.070900	0.070900
Pb-203	2.2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Y-90	2.7	0.000000	0.110200	0.000000	0.000000	0.000000	0.110200
Sb-122	2.7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Mo-99	2.8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
In-111	2.8	0.000000	0.025100	0.000000	0.000000	0.000000	0.025100
Tl-201	3.0	0.000000	0.001000	0.000000	0.000666	0.000000	0.001666
Ga-67	3.3	0.000000	0.001000	0.000000	0.000666	0.000000	0.001666
Re-186	3.8	0.000000	0.006000	0.000000	0.000000	0.000000	0.006000
I-131	8.0	0.000000	0.000000	0.000000	0.000000	0.068300	0.068300
Tl-202	12.2	0.000000	2.928100	0.000000	0.000000	0.000000	2.928100
Ba-140	12.8	0.000000	0.000000	0.000000	0.000000	0.155000	0.155000
P-32	14.3	0.213171	2.334664	0.000000	0.085564	0.000000	2.633400
Os-191	15.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Rb-86	18.7	0.000000	0.001600	0.000000	0.000000	0.000000	0.001600
Th-234	24.1	0.000000	0.014137	0.000000	0.000000	0.000000	0.014137
P-33	25.3	0.000000	0.060600	0.000000	0.000000	0.000000	0.060600
Cr-51	27.7	0.000001	0.181220	0.000000	0.004175	0.307019	0.492415
Yb-169	32.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Ce-141	32.5	0.000000	0.050000	0.000000	0.000000	0.120000	0.170000
Nb-95	35.0	0.000000	0.015122	0.000000	0.000000	0.007873	0.022995
Ru-103	39.3	0.000000	0.005600	0.000000	0.000000	0.002392	0.007992
Fe-59	44.5	0.000002	0.009259	0.000000	0.000000	0.604916	0.614177
Hg-203	46.6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
In-114m	49.5	0.000000	0.055000	0.000000	0.000000	0.000000	0.055000
Sr-89	50.5	0.000000	0.000000	0.000000	0.010000	0.002222	0.012222
I-125	60.1	0.067442	0.300283	0.000000	0.208349	0.000000	0.576074
Sb-124	60.2	0.000000	0.001502	0.000000	0.000000	0.000000	0.001502
Tc-95m	61.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Zr-95	64.0	0.000000	0.007957	0.000000	0.000000	0.000012	0.007969
Sr-85	64.8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Co-58	70.9	0.000000	0.012853	0.000000	0.000000	11.541964	11.554817
Tb-160	72.3	0.000000	0.020000	0.000000	0.000000	0.000000	0.020000
Ir-192	73.8	0.000000	0.256000	0.000000	0.959854	0.000000	1.215854
Sc-46	83.8	0.000000	0.002500	0.000000	0.000000	0.000000	0.002500
S-35	87.2	0.513501	0.643304	0.000000	0.840219	0.000000	1.997024
Total		0.987129	7.065135	0.000000	2.109973	12.880598	23.042834

Table B−2
Inventory of Radionuclides With Half−Lives Greater Than 90 Days and Less Than Five Years Contained in 1993 LLRW Shipped for Disposal − by Generator Category
(curies)

Radionuclide	Half−Life (days)	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
Sn−113	115	0.000000	0.018041	0.000000	0.000000	0.000000	0.018041
Se−75	120	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Po−210	138	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Cm−242	163	0.000000	0.000000	0.000000	0.000000	0.002255	0.002255
Ca−45	163	0.024195	0.106750	0.000000	0.000650	0.000000	0.131595
Au−195	186	0.000000	0.003504	0.000000	0.000000	0.000000	0.003504
Gd−153	242	0.000000	0.016800	0.000000	0.000000	0.000000	0.016800
Zn−65	244	0.000040	0.115360	0.000000	0.000000	0.000001	0.115401
Ag−110m	250	0.000000	0.002653	0.000000	0.000000	5,960.000000	5,960.002653
Co−57	271	0.000004	4.784300	0.000000	0.000923	0.000000	4.785227
Ge−68	271	0.000000	0.005100	0.000000	0.000000	0.000000	0.005100
Ce−144	285	0.000004	0.000000	0.000000	0.000000	1.759202	1.759206
Mn−54	312	0.000005	0.021333	0.000000	0.000000	320.311455	320.332793
Ru−106	372	0.000000	0.000007	0.000000	0.000000	0.002399	0.002406
Cd−109	462	0.070010	0.047600	0.000000	0.000000	956.000000	956.117610
Th−228	693	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Cs−134	753	0.000000	0.001414	0.000000	0.000035	0.003356	0.004805
Na−22	951	0.014217	0.085700	0.000000	0.000141	0.000000	0.100058
Pm−147	958	0.000000	0.218945	0.000000	0.000000	0.000000	0.218945
Fe−55	996	0.000005	1.611994	0.000000	0.000000	5,701.909370	5,703.521369
Sb−125	1007	0.000000	0.000002	0.000000	0.000000	351.000022	351.000025
Tl−204	1161	0.031000	0.286200	0.000000	0.000001	0.000000	0.317201
Total		0.139480	7.325703	0.000000	0.001750	13,290.988061	13,298.454993

Table B-3
Inventory of Radionuclides With Greater Than Five Year Half-Lives Contained in 1993 LLRW Shipped for Disposal – by Generator Category
(curies)

Radionuclide	Half-Life (Years)	Generator Category					Total
		Acad	Comm	Govt	Health	Utility	
Co-60	5.3	0.050000	0.467235	0.000000	0.000500	3,815.419670	3,815.937405
Eu-154	8.6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Ba-133	10.5	0.000101	0.082400	0.000002	0.000100	0.000000	0.082603
Kr-85	10.7	0.000000	30.642000	0.000000	0.000000	0.000000	30.642000
H-3	12.3	7.938961	20,165.170363	0.001300	0.915661	0.039012	20,174.065297
Eu-152	13.5	0.000006	0.000000	0.000000	0.000000	0.000000	0.000006
Pu-241	14.4	0.000000	0.000000	0.000000	0.000000	0.701652	0.701652
Cm-234/44	17.3	0.000000	0.000000	0.000000	0.000000	0.000517	0.000517
Pb-210	22.3	0.000000	0.012500	0.000000	0.000000	0.000000	0.012500
Sr-90	29.1	0.000000	0.038985	0.000038	0.000000	0.909234	0.948258
Cs-137	30.2	0.060013	11.149767	0.000028	0.001341	8.337303	19.548452
Bi-207	32.2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Pu-238	87.7	0.000000	0.000000	0.000000	0.000000	0.001475	0.001475
Ni-63	100.0	0.000000	0.471548	0.180000	0.000000	690.897380	691.548928
Ag-108	130.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Am-241	432.0	0.000000	0.000702	0.000002	0.000000	0.001920	0.002623
Ra-226	1,600.0	0.000106	0.160215	0.000000	0.000001	0.000000	0.160322
C-14	5,730.0	2.550193	6.350823	0.000045	0.022380	0.315009	9.238450
Pu-239/40	6,560.0	0.000000	0.000000	0.000000	0.000000	0.002286	0.002286
Th-230	75,400.0	0.000000	0.001100	0.000000	0.000000	0.000000	0.001100
Ni-59	76,000.0	0.000000	0.000000	0.000000	0.000000	0.013231	0.013231
Tc-99	213,000.0	0.002101	0.014533	0.000292	0.000002	0.000000	0.016928
U-234	246,000.0	0.000000	0.021994	0.000000	0.000000	0.000000	0.021994
Cl-36	301,000.0	0.018781	0.005800	0.000000	0.002100	0.000000	0.026681
I-129	1.6E+07	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
U-236	2.3E+07	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
U-235	7.0E+08	0.000000	0.001280	0.000000	0.000000	0.000000	0.001280
K-40	1.3E+09	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
U-238	4.5E+09	0.000138	5.074295	0.433150	0.000000	0.000000	5.507583
Th-232	1.0E+10	0.000416	0.008290	0.000400	0.000000	0.000000	0.009106
Total		10.620816	20,219.673829	0.615258	0.942085	4,516.638688	24,748.490675

Table B-4
Inventory of Radionuclides With Greater Than Five Year Half-Lives Contained in 1993 LLRW Shipped for Disposal – by Disposal Class
(curies)

	Half-Life	Disposal Classification					
Radionuclide	(years)	Class A	Class AH	Class B	Class C	Total	% of Total
Co-60	5.3	328.427405	0.000000	3,487.510000	0.000000	3,815.937405	15.4
Eu-154	8.6	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
Ba-133	10.5	0.082603	0.000000	0.000000	0.000000	0.082603	0.0
Kr-85	10.7	30.642000	0.000000	0.000000	0.000000	30.642000	0.1
H-3	12.3	208.189767	0.000000	19,965.875530	0.000000	20,174.065297	81.5
Eu-152	13.5	0.000006	0.000000	0.000000	0.000000	0.000006	0.0
Pu-241	14.4	0.026852	0.000000	0.674800	0.000000	0.701652	0.0
Cm-234/44	17.3	0.000517	0.000000	0.000000	0.000000	0.000517	0.0
Pb-210	22.3	0.012500	0.000000	0.000000	0.000000	0.012500	0.0
Sr-90	29.1	0.063221	0.000036	0.885000	0.000000	0.948258	0.0
Cs-137	30.2	16.014386	0.000026	3.534040	0.000000	19.548452	0.1
Bi-207	32.2	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
Pu-238	87.7	0.000688	0.000000	0.000787	0.000000	0.001475	0.0
Ni-63	100.0	330.603928	0.000000	360.945000	0.000000	691.548928	2.8
Ag-108	130.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
Am-241	432.0	0.001543	0.000000	0.001080	0.000000	0.002623	0.0
Ra-226	1,600.0	0.160216	0.000000	0.000000	0.000106	0.160322	0.0
C-14	5,730.0	9.231705	0.000045	0.006700	0.000000	9.238450	0.0
Pu-239/40	6,560.0	0.000876	0.000000	0.001410	0.000000	0.002286	0.0
Th-230	75,400.0	0.001100	0.000000	0.000000	0.000000	0.001100	0.0
Ni-59	76,000.0	0.013231	0.000000	0.000000	0.000000	0.013231	0.0
Tc-99	213,000.0	0.016636	0.000292	0.000000	0.000000	0.016928	0.0
U-234	246,000.0	0.021994	0.000000	0.000000	0.000000	0.021994	0.0
Cl-36	301,000.0	0.026681	0.000000	0.000000	0.000000	0.026681	0.0
I-129	1.6E+07	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
U-236	2.3E+07	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
U-235	7.0E+08	0.001280	0.000000	0.000000	0.000000	0.001280	0.0
K-40	1.3E+09	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
U-238	4.5E+09	5.404433	0.103150	0.000000	0.000000	5.507583	0.0
Th-232	1.0E+10	0.009106	0.000000	0.000000	0.000000	0.009106	0.0
Total		928.952673	0.103549	23,819.434347	0.000106	24,748.490675	100.0

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